MOTION IMAGERY STANDARDS PROFILE

Department of Defense/Intelligence Community/
United States Imagery and Geospatial Information Service
(DoD/IC/USIGS)
Motion Imagery Standards Board

Version 2.0a

21 March 2002

This Page Left Intentionally Blank

TABLE OF CONTENTS

PREFACE

This document summarizes the Motion Imagery Standards Profile (MISP), formerly known as the Video Imagery Standards Profile (VISP), work to-date by the Department of Defense/Intelligence Community/United States Imagery and Geospatial Information Service (DoD/IC/USIGS) Motion Imagery Standards Board (MISB), formerly known as the Video Working Group (VWG). MISB Points of Contact include:

Mr. Stephen W. Long
Director, Motion Imagery Program Office (MIPO)
Chair, DoD/IC/USIGS Motion Imagery Standards Board (MISB)
Chair, NATO Air Group IV Motion Imagery TST
National Imagery and Mapping Agency (NIMA-ATTM-MIPO)
12300 Sunrise Valley Drive, MS-P78
Reston, Virginia 20191

Voice:	703-262-4415	Mobile:	
	703-262-3400		
Fax:	703-262-4380	Secure Fax:	
	703-262-4110		
STUIII:	703-262-4381	RED:	
	813-0815		

Official E-mail: longsw@nima.mil
SIPRNET: longsw@se.nima.smil.mil
JWICS E-mail: longs@nima.ic.gov
USAFR: stephen.long2@langley.af.mil
Personal E-mail: swlong@mindspring.com
MISB Web Site: http://www.ismc.nima.mil/MISB

Please direct all technical related questions to:

Dr. Guy Beakley
MISB Sr. Scientist
Hicks and Associates, Inc.
1710 SAIC Drive, Suite 1300, McLean, VA 22102
Phone: (703) 676-7114 direct
(703) 676-8670 main
Fax: (703) 676-5813
E-mail: beakleyg@saic.com

Please direct all administrative related questions to:

Deborah Farabee
Business Administrator, Motion Imagery Program Office
National Imagery and Mapping Agency (NIMA-ATTM-MIPO)
12300 Sunrise Valley Drive
Reston, VA 20191
Phone: (703) 262-4305
Fax: (703) 262-4380
E-mail: FarabeeD@nima.com

2   INTRODUCTION

2.1   Scope

In accordance with Department Of Defense Directive Number 5105.60 (dated 11 October 1996), which established the National Imagery and Mapping Agency (NIMA); and whereas: "The NIMA shall provide timely, relevant, and accurate imagery, imagery intelligence, and geospatial information in support of the national security objectives of the United States"; and whereas NIMA shall: "Prescribe and mandate standards and end-to-end technical architectures related to imagery, imagery intelligence, and geospatial information for the DoD Components and for the non-DoD elements of the Intelligence Community…" to include:

- "Standards for end-to-end architectures related to imagery, imagery intelligence, and geospatial information."

- "Technical guidance and direction to all the DoD Components and the non-DoD members of the Intelligence Community regarding standardization and interoperability of systems requiring geospatial information or imagery support", and "for exploitation and dissemination of imagery and imagery intelligence products and geospatial information."

And whereas NIMA shall: "Develop policies and provide DoD participation in national and international imagery, imagery intelligence, and geospatial information activities…"

The Motion Imagery Standards Board (MISB) is hereby designated as the organization, under the supervision of the Geospatial Standards Management Committee – Imagery Standards Management Committee (GSMC-ISMC), to formulate, review and recommend standards for motion imagery, associated metadata, audio and other related systems for use within the Department of Defense / Intelligence Community / United States Imagery and Geospatial Information Services (DoD/IC/USIGS). The MISB will formulate and make recommendations to the GSMC-ISMC on all proposed motion imagery, associated metadata, audio, and other related systems standards for compliance with the technical goals of the DoD Joint Technical Architecture (JTA) and USIGS Technical Architecture (UTA). The MISB will therefore monitor and participate in changes to, and the implementation of, related motion imagery, metadata, audio and associated systems standards in national and international arenas for impacts to DoD/IC/USIGS Systems.

2.2   Motion Imagery Standards Board Mission

Whereas, motion (video) imagery has been recognized by the DoD/IC/USIGS as a fundamentally important source of imagery intelligence, and whereas; improved battle-space/intelligence-space awareness using motion imagery (video) sensors has been identified as a key developing technology area in policy documents such as DoD Joint Vision 2010; the mission of the MISB is to ensure the development, application and implementation of standards that maintain interoperability and quality for motion imagery, associated metadata, audio and other related systems in the DoD/IC/USIGS. The MISB will monitor and participate in the development of and changes to adopted standards and

assess their impacts on systems and DoD/IC/USIGS architectures through community input and discussion. Additionally, the MISB will participate in the North Atlantic Treaty Organization (NATO) Standards Agreement (STANAG) process for coalition force interoperability and also participate in US and international standards bodies to monitor, advocate, and represent DoD/IC/USIGS interests for motion imagery, associated metadata, audio, and related systems to support global interoperability and protect image and information quality.

This DoD/IC/USIGS Motion Imagery Standards Profile (MISP) is a direct expression of the MISB mission and serves as the master baseline standards document prepared and managed by the MISB. The JTA, UTA, and NATO will reference the MISB as shown in Figure 1–1 yielding seamless international interoperability for coalition force operations.

The following chronology explains the development of versions of the VISP/MISP:

- Version 1.00 was approved as the baseline document by GSMC-ISMC on 12 June 1997.

- VISP Version 1.10 was approved by GSMC-ISMC on 26 September 1997.

- VISP 1.20 was provisionally approved by the VWG on 19 November 1997.

- VISP 1.21, approved by the VWG on 7 January 1998, was the baseline motion imagery standards document for the Joint Technical Architecture (JTA) Version 2.0.

- VISP 1.30, approved by the ISMC on 6 March 1998, was initially proposed as the motion imagery standards baseline document for the JTA 3.0.

- VISP 1.4, approved by the ISMC on 12 August 1999, was the final baseline motion imagery standards document for the JTA, Version 3.0 and the USIGS Technical Architecture, Revision A, 26 January 1999.

- VISP 1.5 was approved by the GSMC-ISMC on 24 February 2000.

- MISP 1.6 is the motion imagery standards baseline document for the JTA 4.0 and the next revision to the UTA.

- MISP 1.7 was approved by the GSMC-ISMC on 1 March 2001.

All DoD/IC/USIGS organizations that use motion imagery technologies are encouraged to participate in MISB activities and represent their specific requirements and issues.

2.3   MISP Document Format

Chapter 1 provides introductory material applicable to the entire MISP document. Chapter 2 documents APPROVED Commercial Standards, Interoperability Profiles, Recommended Practices and Engineering Guidelines for DoD/IC/USIGS implementations. Please note several special cases in Chapter 2 where clearly identified sub-elements of an approved item still remain in STUDY status.   Appendix A outlines EMERGING Standards, Profiles, and Recommended Practices (RP) that are still in STUDY Status.

To address the need for balance between simply noting a standard and noting the why and how such a standard should be used, the MISP includes appendices which provide supplemental information users can refer to in order to better understand the underlying technical concepts of this document. Appendix B provides detailed citations and references for standards specified in the MISP. Appendix C identifies acronyms and abbreviations and Appendix D is a record of revisions.

The MISP points to a number of documents as normative references. As shown in Figure 1-1 they fall into the categories of Industry Standards that are the due-process standards followed by commercial vendors and developers; and MISB documents specifically developed for motion imagery applications when there are no industry standards to meet specific DoD/IC/USIGS needs. Documents developed by the MISB include the Core Motion Imagery Metadata (formerly known as Core Video Metadata) definitions used in Unmanned Aerial Vehicle (UAV) analog closed captioning; Image Product Libraries (IPLs): the Metadata Dictionary and Encoding document for placing metadata in digital bit streams; the document on National Imagery Transmission Format (NITF) Wrappers for Motion Imagery being developed for the exchange and archival storage of MPEG-2 files; and the document on Motion Imagery, Security, Authentication, and Encryption being developed for the security/releasability marking of motion imagery and associated metadata.
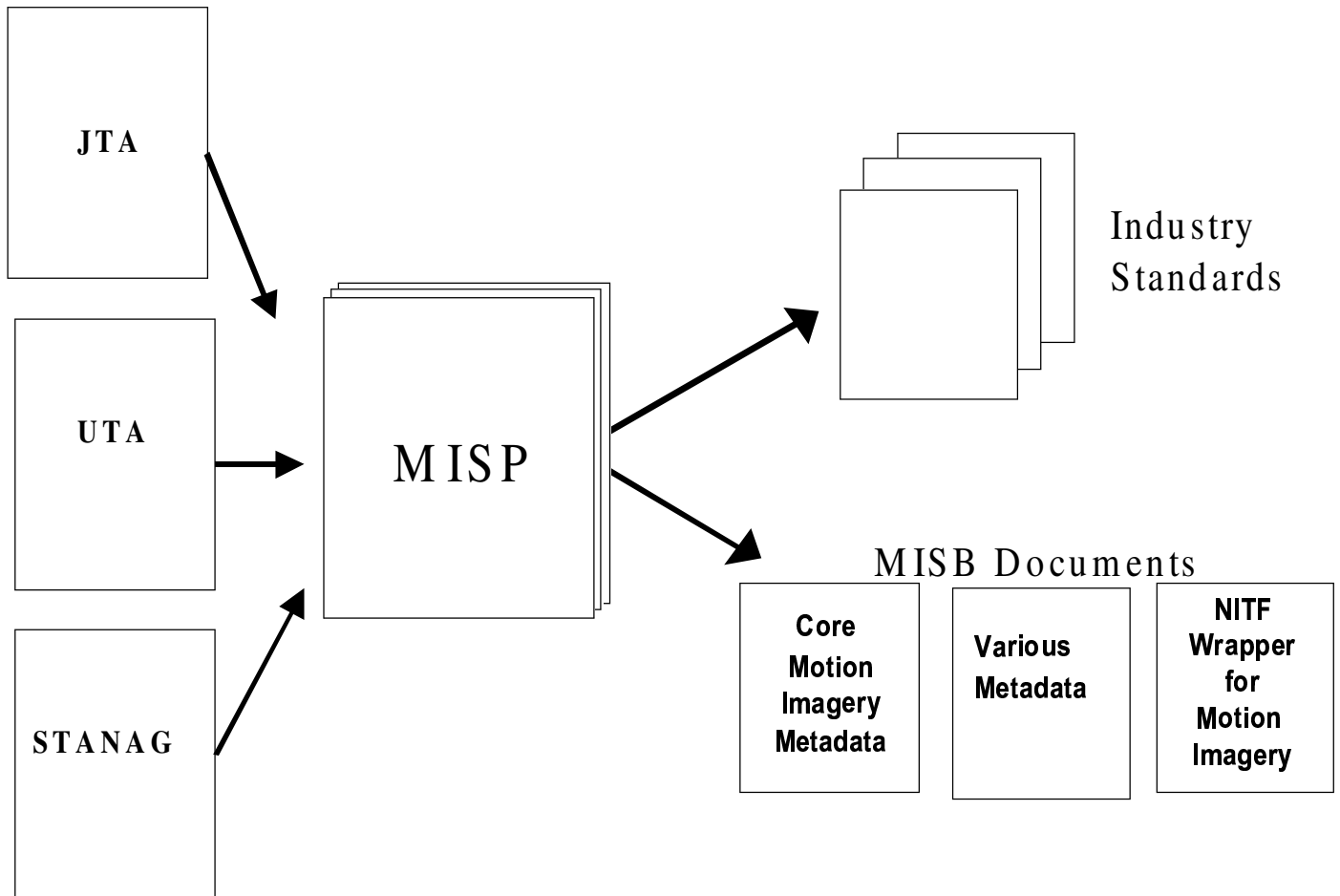
Figure 1-1. Other MISP Referenced Document Categories

2.4   Classes of Motion Imagery and Related Systems

In the broadest context of imagery applications, the major divisions are:

STILL Imagery / MOTION Imagery / SYNTHETIC Imagery

This document addresses applications associated with Motion Imagery.

2.5   Motion Imagery

MOTION Imagery is defined as imaging sensor / systems that generate sequential or continuous streaming images at specified temporal rates (normally expressed as frames per second), ***within a common field of regard***.   MOTION Imagery is defined as nominally beginning at frame rates of 1 Hz (1 frame per second) or higher.

Within the major division of MOTION Imagery, the following domains are currently specified:

1) Electro Optical (including Video and Television)

2) Infrared (including low-light television)

3) Multispectral (MSI)/Hyperspectral (HSI)

2.5.1   Electro Optical Domain

Within the Motion Imagery Electro-Optical domain, specific definitions are given for Video and Television sub-domains:

Video is defined as Electro-Optical motion imagery technologies defined by standards developed by the International Organization for Standards (ISO), International Telecommunication Union (ITU), Society of Motion Picture and Television Engineers (SMPTE), European Broadcasters Union (EBU), etc., reviewed, adopted and profiled for DoD/IC/USIGS applications by designated DoD/IC/USIGS standards bodies such as the MISB.

Television is defined as Video formats and implementations defined by Government Transmission Regulations such as NTSC, PAL, SECAM, FCC 4[h] Report and Order; reviewed, adopted and profiled for DoD/IC/USIGS applications by designated DoD/IC/USIGS standards bodies such as the MISB.

For analog technologies, there has always been a direct coupling of television and video waveforms, production, transmission, and receiver designs. With the advent of digital technologies; production, transmission and receiver systems can be de-coupled. Therefore, the requirements and or limitations of transmission regulations, typically specified for civilian (general public) applications, are not necessarily applicable for DoD/IC/USIGS applications.

2.5.1.1   Motion Imagery Sub-Domains

Motion Imagery systems, defined as electro-optical motion imagery whose formats are governed by national and international standards, are divided into four (4) categories:

1. Motion Imagery Systems (used to create, process, manipulate, exploit, store, archive and disseminate Motion Imagery, nominally video), both for real-time and other end-user wide area product distribution, in support to imaging applications, including (but not limited to) Intelligence, Surveillance, and

Reconnaissance (ISR), Exploitation, and all other motion imagery-based systems not specifically defined below.

2. Video Teleconference Systems provide real-time visual interchange between remote locations typically in support of meetings. When video teleconference systems are used for the display of motion imagery, the standards for motion imagery apply.

3. Video Telemedicine Systems provide real-time visual interchange between remote locations in biomedical applications including fiber optic and video teleconferencing.

4. Video Support Services enable end-user applications associated with motion imagery (video)-based training, newsgathering or other non-critical functions that do not directly support the warfighter. This includes traditional studio and field video productions, which are not associated with DoD warfighter operations.

2.5.2 Infrared

Currently, there are no standards defined for infrared systems. The MISB anticipates beginning an effort in FY02 for the development of such standards. When developed, the standards will be promulgated within future versions of the MISP.

2.5.3 Multispectral/Hyperspectral (MSI/HSI)

There are no standards defined for motion imagery MSI or HSI systems in this version of the MISP.

2.6 Motion Imagery Standards Profile Applicability to DoD/IC/USIGS Communities

The MISP is applicable to all DoD/IC/USIGS motion imagery systems that are subject to the DoD Joint Technical Architecture and the USIGS Technical Architecture. All new motion imagery systems are required to be compliant with provisions of the MISP as soon as practical. All analog motion imagery systems are considered to be legacy systems as of 12 June 1997. In accordance with the MISP, all new systems are required to be based on digital motion imagery technology

Note that by reference here, other classes, communities and users of motion imagery systems (Video Teleconference Systems and Video Telemedicine) are specifically excluded from the mandatory requirements of the MISP. However, when any of these other classes of motion imagery systems are used for the purpose of motion imagery data dissemination then the requirements and provisions of the MISP apply.

These and future to-be-defined motion imagery communities are encouraged to review the applicability of the standards given in the MISP and if deemed practical, implement MISP standards and recommended practices to foster broader interoperability across the entire DoD/IC/USIGS/Federal spectrum. These separate communities are specifically invited to join the DoD/IC/USIGS MISB and merge their requirements into the ongoing development of the DoD/IC/USIGS MISP document.

2.7   Definition of Terms

2.7.1   Standards

Where the MISP term STANDARD is used, the MISP item (chosen by specific MISB adoption, and approved by the GSMC-ISMC), <u>mandates binding technical implementation policy</u>, and as such, should be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government.

For point of clarification, in commercial practice the majority of identified standards (notably those from SMPTE) are considered to be "voluntary" standards, where equipment manufacturers and users are free to choose to comply or to not comply with the standard. <u>Standards</u>, as represented in this MISP <u>are not considered voluntary for DoD/IC/USIGS users and systems. They are mandatory.</u>

2.7.2   Profiles

Where the MISP term PROFILE is used, the MISP item documents an extension to a STANDARD developed or specified to meet DoD/IC/USIGS unique mission requirements not normally covered by commercial standards. MISP PROFILES (chosen by specific MISB adoption, and approved by the GSMC-ISMC) <u>mandate binding technical implementation policy</u>, and as such, should be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government.

2.7.3   Recommended Practices/Engineering Guidelines

Where the MISP term RECOMMENDED PRACTICE is used, the MISP item documents a recommended implementation or practice that further clarifies the implementation of a STANDARD or PROFILE in order to insure interoperability across DoD/IC/USIGS systems. Recommended Practices chosen by specific MISB adoption (as approved by the GSMC-ISMC), should be considered to be a technical implementation policy, and as such, may be identified in Government procurement actions as a mandatory compliance item in order for vendor offerings to be accepted by the Government. Engineering Guidelines represent good engineering principals and therefore, should be implemented if at all possible.

2.7.4   Emerging Standards/Studies

Where the MISP term STUDY is used, the MISP identifies a preliminary version of an anticipated and or emerging STANDARD, PROFILE, RECOMMENDED PRACTICE or Engineering Guideline where the primary initial parameters are outlined and understood but additional coordination or engineering analysis is required. Such items will be forwarded to the appropriate MISB sub-group or ad-hoc committees for action item work-off, with TBD completion suspense dates. At the time of formal adoption, the STUDY will become a standard, profile, recommended practice, or engineering guideline using the same MISP identification number. Until formally adopted by the MISB and GSMC-ISMC <u>there is no requirement to implement any portion of any STUDY item.</u>

2.7.5   Frame Rate Annotation

The MISP has attempted to use the following consistent scanning format and frame rate annotations throughout all of the specified MISP profiles:

60p   = 60 Frames Per Second (FPS), Progressively Scanned

60p/1.001	= 59.94 FPS (NTSC compatible frame rate), Progressively Scanned
50p	= 50 FPS, Progressively Scanned
30p	= 30 FPS, Progressively Scanned
30p/1.001	= 29.97 FPS (NTSC compatible frame rate), Progressively Scanned
25p	= 25 FPS, Progressively Scanned
24p	= 24 FPS, Progressively Scanned
24p/1.001	= 23.98 FPS (NTSC compatible frame rate), Progressively Scanned
30i	= 30 FPS, Interlace Scanned, yielding 60 fields per second
	Note that many commercial documents use the term 60i to mean 30i
30i/1.001	= 29.97 FPS (NTSC frame rate), Interlace Scanned
	This is the frame rate associated with "television" in the United States
25i	= 25 FPS, Interlace Scanned, yielding 50 fields per second
24i	= 24 FPS, Interlace Scanned, yielding 48 fields per second
24i/1.001	= 23.98 FPS (NTSC compatible frame rate), Interlace Scanned

2.7.6   Standard, Enhanced, and High Definition

The MISP has attempted to use the following consistent scanning format definitions throughout all of the specified MISP profiles (see Recommended Practice 9720, Motion Imagery System Matrix for detailed technical specifications for each format):

High Definition (HD) is defined as spatial resolution at or greater than 1280x720 pixels, progressively scanned, at temporal rates at or greater than 24 Hz.

Enhanced Definition (ED) is defined as spatial resolution of at least 720x480 pixels, progressively scanned at temporal rates at or greater than 50 Hz.

Standard Definition (SD) is defined as spatial resolutions at or below 720x576 pixels progressively scanned at temporal rates below 50 Hz, or any interlace scanned format at 720x576 or 720x480.

Note: It is DoD/IC/USIGS policy to migrate to all progressive scanning formats as soon as practical. However, it is recognized that 720x480 and 720x576 interlace systems compose the bulk of existing DoD/IC/USIGS motion imagery imaging systems and that such systems will continue to be used until the end of their practical service life. Such existing interlace systems must not be replaced with new interlace systems.

2.8   DoD/IC/USIGS Motion Imagery Migration Objectives

DoD/IC/USIGS user communities have diverse mission requirements and will select diverse motion imagery systems, across a range of capabilities, to meet system performance objectives. This section outlines the desired end-state of DoD/IC/USIGS motion imagery capabilities. Not all users will require a migration to the highest possible spatial and temporal resolution, but all users should be aware of the target end-objectives for motion imagery capabilities for the DoD/IC/USIGS as described below:

1)   The fundamental end-objective for DoD/IC/USIGS motion imagery systems is to move to all digital, progressive scan processing, and square pixels; moving to higher spatial, temporal, and spectral resolutions as technology becomes available.

2) Standard definition, analog interlace is considered as the legacy initial state, where such analog interlace systems are formally considered to be obsolete systems within DoD/IC/USIGS, and as such must not be replaced with any new analog systems. Within analog families, component processing (R:G:B, Y:R-Y:B-Y, Y:C) is always preferred over composite processing (such as NTSC or PAL).

3) Standard definition, digital interlace (Rec. 601-5, 4:2:2 component processing), using serial digital interfaces (SDI, SMPTE 259M/291M) is a logical and most economical upgrade from analog interlace systems. However, the cost differential between standard definition digital interlace and enhanced definition digital progressive systems is minimal and decreasing, therefore a migration to enhanced definition is strongly advised.

4) Enhanced definition, digital progressive (720 x 480 x 60p and 720 x 576 x 50p) can be considered to yield (as of 2000) the best combination of improved spatial and temporal resolution capabilities at minimal increased costs as compared to today's broadcast quality digital interlace (Rec. 601-5) systems. However, 480p and 576p systems do not utilize square pixels and there are insufficient horizontal pixels to properly deliver 16:9 aspect ratio imagery. Therefore, enhanced definition may be a suitable objective end-state for imagery systems that have no requirement to move to high definition spatial or temporal resolutions and do not require wider (16:9) aspect ratios.

5) High Definition, progressive scan imagery (SMPTE 296M-2001) is the desired end-state for DoD/IC/USIGS motion imagery systems. 1280 x 720x (50p) 60p is the target HD imaging format for all existing and currently planned motion imagery collection systems that will be fielded in the next five to ten years. 1920 x 1080 x (50p) 60p is anticipated to become the revised end-objective in approximately five years (when the technology becomes more mature). User communities that do not require high temporal resolution may consider use of 1920 x 1080 x 24p/25p/30p systems in special limited applications with controlled environments (such as studio production, training, etc.). The anticipated dynamic geo-political landscape and military battlespace environment envisioned by Joint Vision 2010 requires a complex trade space of maximal spatial and temporal resolution, thus 1280 x 720 x (50) 60p will remain the objective architecture end-goal.

2.9 General Implementation Notes and Document Philosophy

It is the intent of the MISP to give users a consolidated, clear and concise view of the standards they will need to build and operate motion imagery systems. The MISP includes guidance on uncompressed, compressed, and related motion imagery sampling structures; motion imagery time standards, motion imagery metadata standards, interconnections, and common language descriptions of motion imagery system parameters. All of the technology outlined in the MISP document is based on commercially available (or very near term available) systems and components based on defined open standards.

However, no single commercial motion imagery standard provides all of the guidance necessary to build interoperable systems for use across the diverse missions of DoD/IC/USIGS. Therefore, the MISP is a collection of standards and practices on how component systems based on commercial standards can interconnect and provide interoperable service to DoD/IC/USIGS users. It is useful to consider the MISP to be a specific technology (motion imagery) domain document that defines concepts necessary

for building interoperable, end-to-end motion imagery systems that are based on commercial motion imagery technology. One specific example of the need for clearly defined profiles and recommended practices is the case of MPEG-2, where the commercial MPEG-2 standard broadly defines a capability that maximizes flexibility but does not guarantee interoperability. By carefully selecting "nominal" values from the ranges of choices within a standard, standards management groups and users can better shape interoperability for their classes of applications. It is also noted that in order for standards to achieve interoperability objectives, systems procured for DoD/IC/USIGS missions must have certification authorities that warrant that the systems are compliant with applicable standards and that the systems do what the vendors claim they will do.

The technology of the commercial motion imagery industry, portions of which DoD/IC/USIGS users procure and use to meet government missions, is in a significant transition phase from analog to digital. Over many years, organizations such as SMPTE have worked to standardize motion imagery systems to facilitate interoperability for the <u>highest quality production environments</u>. Such standardization has supported the production industry by giving broadcasters and production centers confidence that systems from multiple vendors would work interchangeably within the production environment while also preserving the highest possible quality. Migration to digital motion imagery production technology has followed similar patterns, where SMPTE standards have been in place for several years to facilitate interoperability of the highest quality digital production systems. Unfortunately, open standards have not been defined for very low data rate motion imagery. For such low bandwidth cases, universal interoperability is rightly a significant concern for DoD/IC/USIGS managers. There are proprietary vendor products that claim "standard" status based on market share but such proprietary products do not presently meet DoD/IC/USIGS guidelines for adoption as approved standards.

Therefore, the MISP identifies commercial standards that define interoperability for high image quality environments and systems (such as common control vans, interconnections nodes, and DoD/IC/USIGS command centers), including high bandwidth transmission of uncompressed and lower bandwidth transmission of compressed motion imagery (video) signals. The MISP also identifies approaches for interoperability between high bandwidth and low bandwidth systems but it does not completely define architecture for interoperability for extremely low bandwidth (below 1.5 Mbps) real-time streaming applications. Standards for such extremely low bandwidth applications are actively under development (See Study 9810). Until such standards are available, users may use MPEG-1 or MPEG-2 4:2:0 MP@ML Adaptive Field Frame standards for low bandwidth motion imagery applications. DoD users that adopt proprietary compression systems for extremely low bandwidth applications are cautioned that such systems are generally not supported by DoD/IC/USIGS and that the interoperability of such systems is not assured.

The Profiles, Recommended Practices and Studies of this document are included to expressly focus DoD/IC/USIGS uses of commercial standards in order to better manage and support mission interoperability. Table 1.1 summarizes the Standards, Interoperability Profiles and Recommended Practices for DoD/IC/USIGS Implementations, and Motion System Recommended Practices forming the basis of this Motion Imagery Standards Profile document. However, Table 1.1 shall not be used in lieu of the detailed descriptions of this document.

**Table 1-1 - Summary of MISP Commercial Standards, Interoperability Profiles and
Recommended Practices**

Item	Formal Standard Tailored by MISP	Common Name of Tailored Standard
2.0 STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES AND ENGINEERING GUIDELINES FOR DoD/IC/USIGS IMPLEMENTATIONS		
2.1 Motion Imagery Systems		
RP 9720 – Motion imagery System Descriptions		Motion Imagery System Matrix (MISM)
Study 9720a – Advanced High Definition Motion Imagery		MISM – Levels 12-14
RP 9720b – High Definition Motion Imagery		MISM – Levels 9-11
RP 9720c – Enhanced Definition Motion Imagery		MISM – Levels 6-8
RP 9720d – Standard Definition Motion Imagery		MISM – Levels 3-5
RP 9720e – Low Spatial/Temporal Motion Imagery		MISM – Levels 1-2
RP 9720f – Very Low Temporal Motion Imagery		MISM – Level 0
RP 9721 – Motion Imagery Tape Formats		
2.2 Standard Definition Motion Imagery		
9601 – Standard Definition Digital Motion Imagery, Compression Systems	ISO/IEC 13818-1,2,3,4	MPEG-2
9701 – Standard Definition Digital Motion Imagery, Compression Systems	ISO/IEC 13818-1,2,3,4	MPEG-2 4:2:2 P @ ML MPEG-2 4:2:0 MP @ ML
9702 – Standard Definition Digital Motion Imagery Sampling Structure	ITU-R BT.601-5	4:2:2 Component Digital Video
9703 – Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing	SMPTE 259M – 1997	Serial Digital Interface (SDI)
9704 – Digital Motion Imagery, Compression Conversions	ITU-R BT.601-5 SMPTE 259M – 1997	4:2:2 Component Digital Video Serial Digital Interface (SDI)
9705 – Standard Definition Digital Motion Imagery, Format Conversions	ITU-R BT.601-5 SMPTE 259M – 1997	4:2:2 Component Digital Video Serial Digital Interface (SDI)
9707 – Standard Definition Digital Motion Imagery Tape Recorder, Digital Motion Imagery Server, and Similar Systems Input/Output Protocol	SMPTE 259M – 1997 IEEE 1394	Serial Digital Interface (SDI) HP Serial Bus
9803 - Serial Data Transport Interface	SMPTE 305.2M - 2000	SDTI
9901 – Fiber Optic Interfaces Uncompressed Baseband Signal Transport and Processing	SMPTE 297M – 1997 SMPTE 259M - 1997	Fiber Optic Standard Connector Types
RP 9902 – Authorized Limited Application of DV Format Video	DV Format IEEE 1394	DV Format Video HP Serial Bus
Migration to Digital		
9719 – Analog Video Migration	ANSI/SMPTE 170M – 1999 ITU-R BT.601-5	Analog Video 4:2:2 Component Digital Video
9709 – Use of Closed Captioning for Core Metadata Analog Video Encoding	EIA-608 (Data Services) 47 CFR 15.119 [EIA-708 for HDTV]	Recommended Practice for Line 21
2.3 Enhanced Definition Motion Imagery		
9811 – Progressively Scanned Enhanced Definition Digital Motion Imagery	ITU-R BT.1358 SMPTE 294M - 1997	Progressive Scan EDTV

Item	Formal Standard Tailored by MISP	Common Name of Tailored Standard
2.4 High Definition Motion Imagery		
9710 – High Definition Television Systems (HDTV)	SMPTE 274M – 1998 SMPTE 292M – 1998 SMPTE 296M – 1997 SMPTE 295M - 2001	1920x1080 HDTV and Interface Bit-Serial Interface 1280x720 HDTV and Interface 1920x1080 50 Hz HDTV and Interface
9723 – Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems	ISO/IEC 13818 - 1,2,3,4 ATSC Doc. A/53	MPEG-2 4:2:2 Profile @ HL MPEG-2 4:2:0 MP @ HL U.S. Advanced Television
9703 – Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing	SMPTE 292M - 1998	Serial Digital Interface (SDI) Bit-Serial Interface
2.5 Low Spatial/Temporal Motion Imagery		
9706 – Video Image Still Frames	MIL STD 2500B - NITF 2.1	Video Still Specification
2.6 Metadata		
9708 – Embedded Time Reference for Video Systems	SMPTE 12M – 1999 SMPTE 309M – 1999	SMPTE Time Code MJD
9711 – Intelligence Motion Imagery Index, Geospatial Metadata	Core Motion Imagery Metadata Profile	Core Metadata V 1.0, 14 Mar 97
9712 – Intelligence Motion Imagery Index, Content Description Metadata (Dynamic Metadata Dictionary Structure and Contents)	SMPTE 335M - 2001 SMPTE RP210.3 - 2001 SMPTE EG 37 - 2001	Metadata Dictionary Structure Metadata Dictionary Contents Dictionary Node Structure
9713 – Data Encoding Using Key-Length-Value (KLV)	SMPTE 336M - 2001	KLV Protocol
9714 – Time Code Embedding	ITU-R BT.601-5 SMPTE 259M –1997 SMPTE 292M – 1998 SMPTE 309M – 1999	D-VITC SMPTE Ancillary Time Code SMPTE Ancillary Time Code MJD
9715 – Time Reference Synchronization		Time Code synchronized to GPS
9716 – Packing KLV Packets into SMPTE 291 Ancillary Data Packets	SMPTE 291M - 1998	SDI Bit-Serial Interface Metadata Encoding
9717 – Packing KLV Packets into MPEG-2 Systems Streams	ISO/IEC 13818-1,2,3,4 ISO/IEC 13818-1:2000/ FPDAM 1 SMPTE RP 217	MPEG-2 Metadata Encoding
9718 – Packing KLV Packets into AES3 Serial Digital Audio Streams	AES-3 SMPTE 355M -2001	AES-3 Metadata Encoding
RP 0101 – Use of MPEG-2 System Streams in Digital Motion Imagery Systems		
RP 0102 – Security Metadata Universal Set for Digital Motion Imagery		
RP 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery		
EG 0104 - Basic Predator KLV Metadata		
0107 - Bit and Byte Order for Metadata in Motion Imagery Files and Streams		big-endian
Item	**Formal Standard Tailored by MISP**	**Common Name of Tailored Standard**
2.7 File Formats		
RP 0106 – Advanced Authoring Formats	AAF	AAF
RP 0107 – Material Exchange Format	MXF	MXF

Table 1-1 (Continued)

Item	Formal Standard Tailored by MISP	Common Name of Tailored Standard
A. EMERGING STANDARDS, INTEROPERABILITY PROFILES AND RECOMMENDED PRACTICES FOR DoD/IC/USIGS IMPLEMENTATIONS		
Study 9801 – MPEG-4	ISO/IEC 14496	Coding of Audiovisual Objects
Study 9802 – MPEG-7	ISO/IEC CD 15938-1	Multimedia content description interface
Study 9803 – Serial Data Transport Interface	SMPTE 305.2M-2000	SDTI – Content Package
Study 9804 – Colorimetry		
Study 9805 – Standard Motion Imagery Test Materials		
Study 9806 – Motion Imagery Concatenation Image Quality Protection		
Study 9807 – Motion Image Quality Metrics		
Study 9808 – Still Imagery Derived from Motion Imagery		
Study 9809 – Audio Interchange	SMPTE 259M – 1997 SMPTE 292M - 1998 ISO/IEC 13818 - 3	AES3 Audio AES3 Audio MPEG-2 Audio; Dolby AC-3
Study 9810 – Low Bit-Rate Motion Imagery		
Study 9903 - MPEG-2 Embedded Subheader	ISO/IEC 13818-1,2 MIL STD 2500B - NITF 2.1	MPEG-2 Video Still Specification
Study 9904 - NITF Support for Motion Imagery	ISO/IEC 13818-1,2 MIL STD 2500B - NITF 2.1	MPEG-2 Video Still Specification
Study 0002 – MPEG and KLV Interoperability		
Study 0003 – Advanced High Definition Television		
Study 0004 – Motion Imagery Security, Authentication, and Encryption		
Study 0105 - Unmanned Vehicle KLV Metadata		
Study 0106 – Advanced File Formats	AAF, MXF	AAF, MXF
Study 0108 – Metadata for Scathe View		
Study 0109 - Precision Engagement Metadata		

3   STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES AND ENGINEERING GUIDELINES FOR DoD/IC/USIGS IMPLEMENTATIONS

3.1   Motion Imagery Systems

3.1.1   RECOMMENDED PRACTICE 9720 - Motion Imagery System Matrix

A "Motion Imagery Systems (Spatial and Temporal) Matrix" (MISM) shall define a Recommended Practice for the simple identification of broad categories of Motion Imagery Systems. The intent of the MISM is to give user communities an easy to use, common shorthand reference language to describe the fundamental technical capabilities of DoD/IC/USIGS motion imagery systems. The "Motion Imagery Systems Matrix" includes tables of Technical Specifications and related Notes.

Furthermore, the "Motion Imagery System Matrix - Levels" (MISM-L0 – MISM-L14, where MISM-L14 defines the highest spatial and temporal resolution systems) should only be applied to a single processing node of the end-to-end motion imagery chain, with the overall system specification equaling, at best case, the lowest motion imagery system processing node specification.

The MISM (RP 9720, Revision 1) has six general bands:

9720a – Advanced High Definition Motion Imagery
            (MISM-L12 –MISM-L14)
9720b - High Definition Motion Imagery (MISM-L9 – MISM-L11)
9720c – Enhanced Definition Motion Imagery (MISM-L6 – MISM-L8)
9720d - Standard Definition Motion Imagery (MISM-L3 - MISM-L 5)
9720e - Low Spatial/Temporal Definition Motion Imagery
            (MISM-L2 and MISM-L1)
9720f – Very Low Temporal Definition Motion Imagery (MISM-L0)

Table 4.1 depicts the general outline of the MISM-L. The following Tables and their accompanying Technical Notes provide detailed technical specifications of the general performance of each MISM-L level. Please note that the technical parameters of each major MISM-L sub-division will be individually evaluated for adoption by the MISB and the GSMC-ISMC. The detailed technical specifications of MISM-L levels that have not been formally adopted by GSMC-ISMC remain in STUDY status.

MISM-L includes new tabular descriptions of Motion Imagery system attributes, to include: Spatial Definition (Very High, High, Enhanced, Standard, Low, Very Low); Temporal Definition (Very High, Medium to High, Standard, Low, Very Low); Generation Resiliency (High, Medium, Low, Very Low).

RP	MISM-L	Description
9720a	14	
	13	**Advanced High Definition Motion Imagery**
	12	
9720b	11	
	10	**High Definition Motion Imagery**
	9	
9720c	8	
	7	**Enhanced Definition Motion Imagery**
	6	
9720d	5	
	4	**Standard Definition Motion Imagery**
	3	
9720e	2	**Low Spatial/Temporal Definition Motion Imagery**
	1	
9720f	0	**Low Temporal Definition Motion Imagery**

Table 4-1. Motion Imagery System (Spatial and Temporal) Matrix-Levels (MISM-L)

(VWG, 10 July 1997 - Adopted) (ISMC, 26 September 1997 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved)(27 July 2000 –Editorial Changes)

3.1.2   STUDY 9720a - MISM, Advanced High Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L14	Advanced High Definition (AHD) /	Very High	Very High	High	TBD	≥ 1920	≥ 1080p	8 or 10 or 12	50 – 120 FPS	Zero	3 Gb/s	TBD	OC-96-192
MISM-L13	Advanced HD / Processing / Archiving	Very High	Very High	Medium	TBD	≥ 1920	≥ 1080p	8 or 10	50 – 120 FPS	TBD	TBD	TBD	TBD
MISM-L12	Advanced HD / Distribution	Very High	Very High	Low	TBD	≥ 1920	≥ 1080p	8	50 – 120 FPS	TBD	TBD	TBD	TBD

Table 4-2. Advanced High Definition Motion Imagery (Study 9720a)

STUDY 9720a - MISM, Advanced High Definition Motion Imagery, Technical Notes

MISM-L14   Motion Imagery System Matrix-Level 14 (MISM-L14), Uncompressed Advanced High Definition Motion Imagery, is defined as including the following specific acquisition formats:

    1920 x 1080, frame rates 60p, 50p; 16:9 Aspect Ratio;

    MISL14 Note 1: Only PROGRESSIVE SCAN formats are authorized for advanced high definition DoD/IC/USIGS Motion Imagery acquisition applications (systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance).

MISM-L13   Motion Imagery System Matrix Level 13 (MISM-L13), Mezzanine Compression Advanced High Definition Motion Imagery is defined as any HD format of MISM-L14 using mild compression. MISM-L13 is intended to describe Advanced HD signals that use mild compression to process and transport Advanced HD signals.

MISM-L12   Motion Imagery System Matrix-Level 12 (MISM-L12) is defined as any HD format of MISM-L14/13 that is highly compressed to use end-user (final link) transport delivery.

(Recommend for Study 8 June 1999) (27 July 2000 – Editorially Revised)

3.1.3 RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L11	High Definition (HDTV) / Acquisition	High	Medium -High	High	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M	1280-1920	720p - 1080p	8 or 10 or 12	24 - 60FPS	Zero	1.485 Gb/s	0.885 Gb/s - 4.5 Gb/s	SMPTE 292M, OC-48-96
MISM-L10	HDTV / Processing / Archiving	High	Medium -High	Medium	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M MPEG-2 4:2:2@HL	1280-1920	720p - 1080p	8 or 10	24 - 60FPS	2.5:1 – 5.5:1	360 Mb/s	270 Mb/s - 360 Mb/s	SDI, OC-12
MISM-L9	HDTV / Distribution	High	Medium -High	Low	SMPTE 296M-2001, Progressive modes of SMPTE 274M, 295M MPEG-2 MP@HL	1280-1920	720p - 1080p	8	24 - 60FPS	45:1	19.4 Mb/s	19.4 Mb/s - 44.7 Mb/s	Half to Full T3, ATM

Table 4-3. High Definition Motion Imagery (Recommended Practice 9720b)

RECOMMENDED PRACTICE 9720b - MISM, High Definition Motion Imagery, Technical Notes

MISM-L11 Motion Imagery System Matrix-Level 11 (MISM-L11), Uncompressed High Definition Motion Imagery, is defined as including the following specific acquisition formats:

<div align="center">

1920 x 1080, frame rates 30p, 25p, 24p; 16:9 Aspect Ratio;

1280 x 720, frame rates 60p, 50p, 30p, 25p, 24p; 16:9 Aspect Ratio

</div>

 MISM-L11 Note 1: Only PROGRESSIVE SCAN formats are authorized for high definition DoD/IC/USIGS Motion Imagery acquisition applications (systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance).

 MISM-L11 Note 2: 1920x1080x30i (60 field per second interlace) or 1920x1080x25i (50 field per second interlace) systems are not recommended but may be considered for end-user display systems in non-critical applications.

MISM-L10 Motion Imagery System Matrix-Level 10 (MISM-L10), Mezzanine Compression High Definition Motion Imagery is defined as any HD format of MISM-L11 using mild compression. MISM-L10 is intended to describe HD signals that use mild compression to transport and process HD signals using SMPTE 259M bit-serial interfaces (SDI). Therefore, all MISM-L10 primary routing and distribution hardware systems must comply with SMPTE 259M Level D (360 Mb/s) implementations.

MISM-L9 Motion Imagery System Matrix-Level 9 (MISM-L9) is defined as any HD format of MISM-L11/10 that is highly compressed to use end-user (final link) transport delivery, such as the ATV transport delivery system in the US. MISM-L9 may also include other transport layer delivery systems used by US Treaty partners.

(VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved) (MISB, 27 July 2000 – MISB Standard Recommended and Editorially Revised)

3.1.4　RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L8	Enhanced Definition (ED) / Acquisition	Enhanced	High	High	ITU-R BT.1358, SMPTE 294M-1997	720 - 960	480p - 576p	8 or 10 or 12	50 – 60 FPS	Zero	360 Mb/s	270 Mb/s - 540 Mb/s	SDI, OC-12
MISM-L7	ED / Processing / Archiving	Enhanced	High	Medium	ITU-R BT.1358, SMPTE 294M-1997 MPEG-2 4:2:2@HL	720 - 960	480p - 576p	8 or 10	50 - 60 FPS	7.5:1	44.7 Mb/s	44.7 Mb/s	T3, ATM
MISM-L6	ED/ Distribution	Enhanced	High	Low	ITU-R BT.1358, SMPTE 294M-1997 MPEG-2 MP@HL	720 - 960	480p - 576p	8	50 – 60 FPS	45:1	7.5 Mb/s	5 - 15 Mb/s	GBS, ATM

Table 4-4. Enhanced Definition Motion Imagery (Recommended Practice 9720c)

RECOMMENDED PRACTICE 9720c - MISM, Enhanced Definition Motion Imagery, Technical Notes

MISM-L8   Motion Imagery System Matrix-Level 8 (MISM-L8), Uncompressed Enhanced Definition Motion Imagery, is defined as digital progressive (720x480x60p and 720x576x50p) acquisition formats.

MISM-L8 Note 1: MISM-L8 can be considered to yield (as of 1999) the best combination of improved spatial and temporal resolution capabilities at minimal increased costs as compared to today's broadcast quality digital interlace (Rec. 601-5) systems. However, 720x480p and 720x576p systems do not utilize square pixels and there are insufficient horizontal pixels to properly deliver 16:9 aspect ratio imagery.

MISM-L7   Motion Imagery System Matrix-Level 7 (MISM-L7), Mezzanine Compression Enhanced Definition Motion Imagery is defined as any ED format of MISM-L8 using mild compression. MISM-L7 is intended to describe ED signals that use mild compression to transport and process ED signals using SMPTE 259M bit-serial interfaces (SDI).

MISM-L6   Motion Imagery System Matrix-Level 6 (MISM-L6) is defined as any ED format of MISM-L8/7 that is highly compressed to use end-user (final link) transport delivery systems, such as the ATV transport delivery system in the US. MISM-L6 may also include other transport delivery systems used by US Treaty partners.

MISM-L6 Note 1: MISM-L6 has the advantages of progressive scan, bandwidth efficiency, higher vertical resolution and higher temporal resolution as compared to standard definition television (MISM-L3 – MISM-L5).

(VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved) (27 July 2000 – Editorially Revised)

3.1.5   RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L5	Standard Definition (SD) / Acquisition	Standard	Standard	High	SMPTE 259M (4:2:2)	720	480i – 576i	8 or 10	24 – 30 FPS	Zero to 2.5:1	270 Mb/s	270 Mb/s - 360 Mb/s	SDI, OC-12
MISM-L4	SD / Processing / Archiving	Standard	Standard	Medium	MPEG-2 4:2:2@ML	720	480i – 576i	8	24 - 30 FPS	5.5:1 –10:1	22 - 44 Mb/s	15 – 50 Mb/s	Half to Full T3, ATM
MISM-L3	SD / Distribution	Standard	Standard	Low	MPEG-2 MP@ML	720	480i – 576i	8	24 – 30 FPS	28:1	6 Mb/s	3.8 - 10 Mb/s	GBS, T2, ATM, DVD

Table 4-5. Standard Definition Motion Imagery (Recommended Practice 9720d)

RECOMMENDED PRACTICE 9720d - MISM, Standard Definition Motion Imagery, Technical Notes

MISM-L5   Motion Imagery System Matrix-Level 5 (MISM-L5), Uncompressed Standard Definition Motion Imagery, is defined as uncompressed, 4:2:2 digital interlace motion imagery, including 720 x 480 (to 576) x 24-60 or ITU-R BT.601-5 (4:2:2) Component Video. Note that while both 10 bit and 8 bit implementations are allowed under MISL5, 10 bit implementations are preferred. Note that storage systems (such as some digital motion imagery tape formats) that use bit-serial interface 4:2:2 input/output protocols but use 2.5:1 (near lossless) internal compression will be considered as meeting MISM-L5. Furthermore, all primary routing and distribution hardware systems must comply with SMPTE 259M Level C and D (270/360 Mb/s) implementations to meet MISM-L5. Users are cautioned that true uncompressed processing may be required for the most demanding MISM-L5 applications.

MISM-L4   Digital 4:2:2, MPEG-2 compressed motion imagery, with no more than 10:1 compression. Note that 10:1 compression ratio compliant MPEG-2 4:2:2, Production Profile @ Main Level based systems are anticipated to meet MISM-L4.

MISM-L3   Digital 4:2:0, MPEG-2 compressed motion imagery, with no more than 28:1 compression. Note that MPEG-2 MP@ML based systems are anticipated to meet MISM-L3.

(VWG, 10 July 1997 - Adopted) (ISMC, 26 September 1997 - Approved)(VWG, 19 Nov 1997, Approved as Amended) (VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999, Language Revised and Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved) (27 July 2000 – Editorially Revised)

3.1.6   RECOMMENDED PRACTICE 9720e - MISM, Low Spatial/Temporal Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L2	Low Definition Video (SIF) / Distribution	Low	Low	Very Low	MPEG-2 MP@ML or MPEG-1	352	480i – 576I or 240p - 288p	8	24 - 30 FPS	28:1 –56:1	1.5 Mb/s	1.0 – 1.5 Mb/s	T1
MISM-L1 (Study only)	Very Low Definition Video (QSIF)/ Distribution	Very Low	Very Low	Very Low	TBD (MPEG-4)	176	120p – 144p	8	10– 15 FPS	56:1	512 Kb/s	256 – 768 Kb/s	Half T1

Table 4-6. Low Spatial/Temporal Definition Motion Imagery (Recommended Practice 9720e)
Note: MISM-L1 remains in STUDY Status

RECOMMENDED PRACTICE 9720e - MISM, Low Spatial/Temporal Definition Motion Imagery, Technical Notes

MISM-L2   Digital MPEG-2 (4:2:0, using Adaptive Field Frame techniques) or MPEG-1 compressed video, using SIF image resolution decimation, 25-30 FPS temporal rate, with no more than 56:1 compression.

(VWG, 10 July 1997 - Adopted) (ISMC, 26 September 1997 - Approved)(VWG, 19 Nov 1997, Approved as Amended) (VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved) (27 July 2000 – Editorially Revised)

MISM-L1   Digital compressed motion imagery (including new video compression techniques not currently defined or standardized by the MISB, but having the general attributes of digital 4:2:0), using a combination of image resolution decimation (as low as QSIF) and temporal (frame rate) decimation (on the order of 15 FPS). MISM-L1 is intended as an "end-user motion imagery distribution format of last resort", where severe bandwidth limitations preclude full resolution (spatial and temporal) motion imagery distribution. Furthermore other very low data rate, proprietary compression "Internet video" signal formats (such as AVI and QuickTime) are specifically defined as only meeting MISM-L1 specifications. Note: It is anticipated that future implementations/applications of MPEG-4 will be considered by the MISB to meet the requirements for standardized implementations of MISM-L2 and MISM-L1.

(VWG, 26 March 1997 - Approved for Study) (27 July 2000 – Editorially Revised)

3.1.7 RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Definition Motion Imagery

System Level	Common Description / Intended Application	System Attributes: Spatial Definition	System Attributes: Temporal Definition	System Attributes: Generation Resiliency	Applicable Standard (Note: Other Profiles, Practices may apply)	Nominal Horiz. Res.	Nominal Vert. Res.	Nominal Bit Depth	Frame Rates	Nominal Compression Ratio	Nominal Data Rate	Data Rate Range	Candidate Transport Channels (Nominal Rates)
MISM-L0	Very Low Temporal Motion Imagery / Distribution	High	Very Low	Variable	NITF	720 -1920	480 - 1080	8 or 10 or12	Still - 2 FPS	10:1	256 Kb/s	56 – 512 Kb/s	Non Real Time POTS, ISDN

Table 4-7. Very Low Temporal Motion Imagery (Recommended Practice 9720f)

RECOMMENDED PRACTICE 9720f - MISM, Very Low Temporal Definition Motion Imagery, Technical Notes

MISM-L0   Low frame rate motion imagery based on digital video sources using full MISM-L11/8/5 spatial resolution but having very limited temporal resolution (on the order of stills to 1 or 2 FPS). At these low temporal rates, the imagery is no longer considered to be video (thus the motion imagery nomenclature). MISM-L0 is intended to describe applications where the most severe bandwidth limitations preclude delivery of true motion video. For these very low bandwidth applications, systems should deliver full spatial resolution but may need to severely decimate temporal elements to the point of producing only still frames (and delivering such frames in non-real-time, based on the data rate capacity of the delivery channel). For the specific cases of still imagery derived from video sources, such imagery shall be formatted to conform to NITF standards (see PROFILE 9706 - Video Image Still Frames).

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 – Approved) (27 July 2000 – Editorially Revised)

3.1.8 RECOMMENDED PRACTICE 9721 - Motion Imagery Tape Formats

In reference to Recommended Practice 9720, "Motion Imagery Systems Matrix", the Motion Imagery System Practices for DoD/IC/USIGS motion imagery tape formats shall be as follows:

Tape MISM- Level 11, MISM- Level 8

There are no specific recommendations for uncompressed MISM-L11 or MISM-L8 motion imagery tape implementations as of this version of the Motion Imagery Standards Profile. However, any digital tape format converted into a "bit-bucket" mode with sufficient data bandwidth to store MISM-L11or MISM-L8 signals may be used provided they also:

a)   Transparently transport a minimum of two stereo AES3 audio channels,
b)   Transparently transport Digital Vertical Interval Time Code (D-VITC) (Longitudinal Time Code (LTC) internal processing/storage is authorized provided D-VITC input and output is maintained.),
c)   For MISM-L8, transparently transport a minimum of an additional 6 Mb/s of ancillary data (either as part of the bit-serial interface Ancillary data stream or as additional AES3 audio streams).

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Tape MISM- Level 10, MISM- Level 7

Whereas the Panasonic HD-D5 (HD-2700) format has been forwarded to SMPTE for standardization and eventual assignment of a new SMPTE "D" format number, the HD-D5 format (360 Mbps data rate, using mezzanine compression of authorized DoD/IC/USIGS high and enhanced definition formats such as 1280x720x60p and 720x480x60p) is an authorized initial motion imagery tape implementation partially meeting MISM-L10, MISM-L7 requirements. Other desired MISM-L10 and MISM-L7 attributes include the ability to:

a)   Transparently transport a minimum of two stereo AES3 audio channels,
b)   Transparently transport D-VITC (LTC internal processing/storage is authorized provided D-VITC input and output is maintained),
c)   Transparently transport a minimum of an additional 6 Mb/s of ancillary data (either as part of the bit-serial interface Ancillary data stream or as additional AES3 audio streams).

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Tape MISM- Level 9, MISM- Level 6

The MISB expects that there will be a number of inexpensive tape systems for handling MISM-L9 and MISM-L6 including D-VHS.

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Tape MISM-Level 5

For MISM-L5 implementations authorized motion imagery tape formats may include widely accepted commercial systems that:

a)   Use 4:2:2 digital processing,
b)   Use no compression or use no more than 2.5:1 compression,
c)   Use bit-serial interface input/output protocols,
d)   Transparently transport a minimum of two stereo AES3 audio channels,
e)   Transparently transport D-VITC (LTC internal processing/storage is authorized provided D-VITC input and output is maintained),
f)   Transparently transport a minimum of an additional 6 Mb/s of ancillary data (either as part of the bit-serial interface Ancillary data stream or as additional AES3 audio streams).

Anticipated MISM-L5 compliant (subject to verification) tape formats may include:

SMPTE D1 videotape format

SMPTE D5 videotape format

Ampex DCT videotape format

Sony Digital Betacam tape format

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Tape MISM- Level 4

For MISM-L4 implementations, authorized motion imagery tape formats may include widely accepted commercial systems that:

a)   Use 4:2:2 digital processing,
b)   Have no more than 5:1 compression,
c)   Use bit-serial interface input/output protocols,
d)   Transparently transport a minimum of two stereo AES3 audio channels,
e)   Transparently transport D-VITC (LTC internal processing is authorized provided D-VITC input and output is maintained),
f)   Transparently transport a minimum of an additional 3 Mb/s of ancillary data (either as part of the bit-serial interface data stream or as additional AES3 audio

Anticipated MISM-L4 compliant (subject to verification) tape formats may include:

Any MISM-L5 videotape format
SMPTE D9 (JVC Digital-S) videotape

format

Sony Beta-SX videotape format
SMPTE D7 (DVC Pro 4:2:2) videotape

format

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

MISM- Level 3- MISM- Level 0

For all other Motion Imagery System implementations (MISM-L3-MISM-L0), it is anticipated that <u>information technology based storage systems will be used instead of videotape except for archival purposes</u>. If videotape is used, digital motion imagery tape formats other than MISM-L4 (or higher) may only be used in order to meet specific mission constraints (size, weight, power consumption) that cannot be met with MISM-L4 (or higher) tape formats. In such instances, other such formats may only be used in limited roles such as first generation acquisition, with a requirement to immediately transfer and interface such acquisition formats using SMPTE bit-serial interfaces (with MISM-L4 or higher tape systems) at the first processing interface. See Recommended Practice 9902 for further details.

Anticipated "acquisition-only" tape formats, in order of priority of choice are:

a)   Any MISM-L5 motion imagery tape format
b)   Any MISM-L4 motion imagery tape format
b)   4:1:1 Digital tape formats
c)   Component Analog formats (Y,R-Y,B-Y), such as Betacam-SP or MII
d)   High Resolution Analog formats (Y/C), such as Hi8mm or SVHS

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (VWG, 8 June 1999, Language Revised) (27 July 2000 – Editorially Revised)

Other Video Tape Notes:

"Analog - composite - limited resolution - color under" videotape formats (such as VHS or U-Matic) are not authorized for acquisition, processing or <u>new</u> archive implementations. "Analog - composite - limited resolution - color under" video tape formats may be authorized as the means for video tape mass distribution of finished intelligence products, provided no other digital distribution tape format is widely available. In no case are such formats authorized for <u>new</u> permanent motion imagery archive storage. Existing, legacy archive systems based on "analog - composite - limited resolution - color under" tape formats should convert to one of the new, approved digital tape formats as soon as practical.

Digital composite formats (such as D2, D3) are generally not authorized for any new DoD/IC/USIGS implementations because of their incompatibility with 4:2:2 component processing systems.

No motion imagery tape formats other than MISM-L5 or higher may be used for any new permanent motion imagery tape archives, where MISM-L5 or higher systems should be used for the most demanding applications.

(VWG, 26 March 1997 - Approved for Study) (VWG, 25 February 1998 - Language Revised) (27 July 2000 – Editorially Revised)

3.2   Standard Definition Motion Imagery

3.2.1   STANDARD 9601 – Standard Definition Digital Motion Imagery, Compression Systems

MPEG-2 is the approved motion imagery compression format for DoD/IC/USIGS systems (the VWG and ISMC formally adopted this standard in 1996).

3.2.2   STANDARD 9701 – Standard Definition Digital Motion Imagery, Compression Systems

The 1996 VWG adoption of MPEG-2 (item 9601 above) as the approved motion imagery compression format is hereby superseded by a more detailed specification:

ISO/IEC 13818 - 1,2,3,4 (commonly known as MPEG-2) shall be the DoD/IC/USIGS STANDARD for all standard definition compressed motion imagery, with the following PROFILE specifications:

The "MPEG-2, 4:2:2 Production Profile @ Main Level" (4:2:2 P @ ML) shall be the standard definition motion imagery compression PROFILE for DoD/IC/USIGS origination, acquisition, production, manipulation, exploitation, distribution and archiving where further image processing is anticipated.

The "MPEG-2, 4:2:0 Main Profile @ Main Level" (MP @ ML) shall be the standard definition motion imagery compression PROFILE for DoD/IC/USIGS end-user motion imagery product distribution, including real-time wide area transmissions.

Furthermore, 4:2:0 MP@ML systems may be used where bandwidth limitations preclude the use of 4:2:2 P @ ML and where limited additional processing is anticipated.

9701 Note 1: See Motion Imagery System Recommended Practice 9720 for guidelines concerning applications constrained by low bandwidth channels and low motion imagery data rates, that may not support the use of 4:2:2 P @ ML or MPEG-2.

9701 Note 2: See Motion Imagery System Recommended Practice 9902 for guidelines concerning other digital motion imagery compression formats (such as DV).

(ISMC, 6 March 1998- Approved) (VWG, 21 January 1999 - Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended)

3.2.3   STANDARD 9702 – Standard Definition Digital Motion Imagery Sampling Structure

ITU-R BT.601-5 Component (4:2:2) Digital Video shall be the DoD/IC/USIGS STANDARD sampling structure for baseband (uncompressed) standard definition motion imagery signals.

Furthermore, while both 10 bit and 8 bit implementations are allowed under the standard, 10 bit implementations are preferred.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.4   STANDARD 9703 - Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing

SMPTE 259M (4:2:2) standard definition (270-360 Mb/s Serial Digital Interface - SDI) and SMPTE 292M high definition (1.5 Gb/s Bit-Serial Interface) shall be the uncompressed baseband signal transport and processing DoD/IC/USIGS STANDARDS for digital motion imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

Furthermore, all DoD/IC/USIGS standard definition primary routing and distribution motion imagery hardware systems must comply with SMPTE 259M Levels C and D (270/360 Mb/s) implementations (270 /360 Mb/s data rates allow routing and distribution systems to pass both 4:3 and 16:9 aspect ratio digital motion imagery signals).

Furthermore, within SDI or bit-serial interfaces, one AES3 audio channel (one stereo pair) shall be reserved for mission audio (such as narration), one AES3 audio channel (one stereo pair) shall be reserved for mission metadata encoding.

Furthermore, at least 6 Mb/s of ancillary data (separate from the AES3 requirements above) shall be reserved for metadata encoding.

Furthermore, bit-serial interfaces shall be the DoD/IC/USIGS STANDARD protocol for compression system input signals and decompression system outputs when further processing is required.

> 9703 Note 1:   The "Connector Type" specification given in SMPTE 259M, Section 4, or 292M recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/USIGS users, such physical connections and cable types can be considered to be Recommended Practices, not Standards. (Flexibility to use connectors other than BNC is given to accommodate operational directives, which do not allow BNC connectors in aircraft systems.)

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999 – Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended)

> 9703 Note 2:   Further research is required (see STUDY 9806) to define the anticipated quality degradation of multiple "generation" (compression, decompression, compression...) concatenation effects.

(VWG, 26 March - Approved for Study)

3.2.5   STANDARD 9704 - Digital Motion Imagery, Compression Conversions

ITU-R BT.601-5 shall be the transitional sampling structure, compression conversion and processing DoD/IC/USIGS STANDARD for standard definition digital motion imagery, audio and metadata, where the input compressed motion imagery stream shall be uncompressed into ITU-R BT.601-5 Component (4:2:2) baseband video sampling structure (within bit-serial interface input/output signal processing equipment) and then shall be re-compressed into the target compression format.

> 9704 Note 1: For guidelines on use of multiple compression conversion cycles see Motion Imagery System Recommended Practice 9720.

9704 Note 2: The "Connector Type" specification given in SMPTE 259M, Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/USIGS users, such physical connections and cable types can be considered to be Recommended Practices, not Standards.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 - Approved)

3.2.6   STANDARD 9705 – Standard Definition Digital Motion Imagery, Format Conversions

ITU-R BT.601-5 shall be the transitional sampling structure, format conversion and processing DoD/IC/USIGS STANDARD for standard definition digital motion imagery, audio and metadata, where the input video format is converted into ITU-R BT.601-5 Component (4:2:2) baseband video (within bit-serial interface input/output signal processing equipment) and is then re-formatted into target formats (such as 625 line component systems).

9705 Note 1:   The "Connector Type" specification given in SMPTE 259M, Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/USIGS users, such physical connections and cable types can be considered to be Recommended Practices, not Standards.

9705 Note 2:   This format conversion is intended to facilitate equipment interoperability between 525/30i (American) and 625/25i (NATO and Treaty Partner) motion imagery systems, where the SDI bit-serial interface has been designed for common digital motion imagery parameters wherever practical.

(VWG, 16 Jan 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.7   STANDARD 9707 – Standard Definition Digital Motion Imagery Tape Recorder, Digital Motion Imagery Servers, and Similar Systems Input / Output Protocol

SMPTE 259M shall be the DoD/IC/USIGS STANDARD motion imagery input/output protocol for standard definition digital videotape recorder, digital motion imagery servers, and similar systems.

9707 Note 1:   The "Connector Type" specification given in SMPTE 259M, Section 4, recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/USIGS users, such physical connections and cable types can be considered to be Recommended Practices, not Standards.

Furthermore, "fiber channel" input/output protocols may be considered for digital motion imagery tape recorders, digital motion imagery servers, and similar systems provided such systems also have bit-serial interfaces available.

Furthermore, IEEE 1394 input/output protocols may be considered for digital motion imagery tape recorders, digital motion imagery servers, and similar systems provided such systems also have bit-serial interfaces available or that transparent conversion (from IEEE 1394 to bit-serial) interfaces are available.

9707 Note 2: IEEE 1394 defines a transport channel upon which multiple motion imagery (and other signal) sampling structures may be delivered. Systems that use the IEEE 1394 interface (such as "DV" format tape recorders) may not produce motion imagery sampling structures that meet the standards profiled in this MISP document. Users are cautioned to verify the video sampling structure delivered by any device that claims digital video delivery via IEEE 1394

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.8   STANDARD 9803 - Serial Data Transport Interface

SMPTE 305.2M-2000, *Serial Data Transport Interface (SDTI),* shall define the DoD/IC/USIGS Standard for data stream used to transport packetized data within a studio/production center environment. The data packets and synchronizing signals are compatible with ANSI/SMPTE 259M.

(MISB, 7 February 2001 – SMPTE 305.2M-2000 Adopted; 01 March 2001 GSMC-ISMC Approved)

3.2.9   STANDARD 9901 – Fiber Optic Interfaces Uncompressed Baseband Signal Transport and Processing

SMPTE 297M shall be the fiber optic uncompressed standard definition (270-360 Mb/s) Serial Digital Interface for baseband signal transport and processing DoD/IC/USIGS STANDARD for digital motion imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

Furthermore, all DoD/IC/USIGS standard definition primary routing and distribution motion imagery hardware systems must comply with SMPTE 259M Levels C and D (270/360 Mb/s) implementations (270 /360 Mb/s data rates allow routing and distribution systems to pass both 4:3 and 16:9 aspect ratio digital motion imagery signals).

Furthermore, within SDI or bit-serial interfaces, one AES3 audio channel (one stereo pair) shall be reserved for mission audio (such as narration), one AES3 audio channel (one stereo pair) shall be reserved for mission metadata encoding.

Furthermore, at least 6 Mb/s of ancillary data (separate from the AES3 requirements above) shall be reserved for metadata encoding.

Furthermore, bit-serial interfaces shall be the DoD/IC/USIGS STANDARD protocol for compression system input signals and decompression system outputs when further processing is required.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.2.10 RECOMMENDED PRACTICE 9902 – Authorized Limited Applications of DV Format Video

Consumer cameras that capture digital motion imagery in near-professional quality using the Digital Video (DV) format are now available commercially and at low cost. In addition, the DV proprietary format is being transitioned from a proprietary standard to a published standard within SMPTE.

For "handheld" motion imagery applications the DV format promises a good tradeoff between image quality and system cost. Therefore, DV video format is authorized for specialized DoD/IC/USIGS applications requiring the use of consumer-grade palm-sized camcorders to meet limited, low profile (covert) mission requirements, provided that: 1) No less than 1st generation DV footage will be directly digitally transferred into computer processing systems using IEEE 1394 interfaces; 2) Such motion imagery DV clips will not be forwarded nor interfaced to any DoD/IC/USIGS communications nodes for subsequent processing.

Affordable devices are now commercially available to convert from the DV format to MISP approved digital formats for distribution and exploitation. (For example, a single chip is available that converts 25 Mbps DV to 6 Mbps MPEG-2.) Thus, DV-originated motion imagery that meets the above criteria may be distributed when it is converted to an approved digital format such as MPEG-2.

(VWG, 21 January 1999 – Adopted; VWG, 8 June 1999 – Language Revised) (VWG, 8 June 1999, Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved)

3.2.11 STANDARD 9719 - Analog Video Migration

All DoD/IC/USIGS motion imagery production systems that currently use ANSI/SMPTE 170M analog video waveforms (also known as RS-170A) should convert to ITU-R BT.601-5 Component (4:2:2) digital sampling structure as soon as practical.

Furthermore, all new digital baseband motion imagery system production sampling structures shall conform to ITU-R BT.601-5 Component (4:2:2) sampling structures.

Furthermore, unique mission systems with legacy analog video waveforms should convert such analog video waveforms to ITU-R BT.601-5 Component (4:2:2) sampling structures as soon as possible in the signal processing chain, with no processing node backwards conversions to analog waveforms allowed.

(VWG, 26 March 1997 - Approved for Study) (VWG, 19 November 1997- Approved)

3.2.12 STANDARD 9709 - Use of Closed Captioning for Core Metadata Analog Video Encoding

EIA-608 (Data Services), commonly known as closed captioning, shall be the DoD/IC/USIGS STANDARD for legacy system analog video vertical interval metadata encoding using video line 21.

Note that any such analog video system data encoding is to be considered for legacy analog systems and may also be implemented by new systems for redundancy. New systems shall also conform to all applicable digital motion imagery, audio, and metadata protocols specified in the MISP.

MISP item 9711 shall be the basis for Geospatial metadata descriptions for DoD/IC/USIGS systems using Closed Captioning (until replaced by Motion Imagery Standards Profile item 9713).

MISP item 9714 shall be the basis for time references for analog video vertical interval data. Therefore, Motion Imagery Standards Profile item 9709 implementations should not be burdened with duplicate time reference data.

Furthermore, to facilitate universal inter-operability, DoD/IC/USIGS users are encouraged to submit recommended implementations for analog closed captioning

systems for consideration and inclusion in this Motion Imagery Standards Profile document by the MISB as numbered Recommended Practices.

(VWG, 16 Jan 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)

3.3   Enhanced Definition Motion Imagery

3.3.1   STANDARD 9811 – Progressively Scanned Enhanced Definition Digital Motion Imagery

ITU-R BT.1358 shall define the DoD/IC/USIGS STANDARD motion imagery sampling structure for progressively scanned, digital enhanced definition motion imagery systems.   Parallel connector interfaces shall not be used if bit-serial interfaces are

 Furthermore, while both 10 bit and 8 bit implementations are allowed under the standard, 10 bit implementations are preferred.

SMPTE 294M-1997 shall define the DoD/IC/USIGS Recommended Practice for Bit-Serial Interfaces for 720 x 483 progressively scanned digital motion imagery systems.

(VWG, 25 February 1998 - Approved) (ISMC, 6 March 1998 - Approved)(MISB, 24 May 2001, BT.1358 replaces SMPTE 293M)

3.4   High Definition Motion Imagery

3.4.1   STANDARD 9710 - High Definition Television Systems (HDTV)

SMPTE Standard 296M-2001 shall define the DoD/IC/USIGS STANDARD motion imagery sampling structure for progressively scanned digital high definition systems based on 720 vertical scanning lines. The standard incorporates multiple frame rates such as 24, 25 and 50 Hz. The parallel connector interface defined for SMPTE 296M-2001 shall not be used if bit-serial interfaces are available.

SMPTE 292M-1998 shall define the DoD/IC/USIGS STANDARD for bit-serial interfaces for high definition television systems, including by specific reference SMPTE 296M-2001.

SMPTE 274M-1998 shall define the DoD/IC/USIGS STANDARD motion imagery sampling structures for progressively scanned digital high definition systems based on 1080 vertical scanning lines.

(VWG, 25 February 1998 - Approved) (ISMC, 6 March 1998 - Approved) (MISB, 27 July 2000 – Submitted)(02 November 2000 GSMC-ISMC Approved)(MISB, 7 February 2001- SMPTE 296M-2001 adopted; 01 March 2001 GSMC-ISMC Approved)

3.4.2   STANDARD 9723 – Compressed High Definition Advanced Television (ATV) and Associated Motion Imagery Systems

ISO/IEC 13818 – 1 (Systems), 2 (Video) (commonly known as MPEG-2) "High Level", which defines a broad family of high definition video compression capabilities, shall be the DoD/IC/USIGS STANDARD for compressed high definition advanced television and motion imagery, with the following PROFILE specifications:

The MPEG-2, 4:2:2 Profile @ High Level (4:2:2P @ HL) shall be the high definition motion imagery compression PROFILE for DoD/IC/USIGS origination, acquisition, production, manipulation, exploitation, distribution and archiving where further image processing is anticipated.

The MPEG-2, Main Profile (4:2:0) @ High Level (MP @ HL), shall be the high definition motion imagery compression PROFILE for DoD/IC/USIGS end-user motion imagery product distribution, including real-time wide area transmissions.

Furthermore, 4:2:0 MP@HL systems may be used where bandwidth limitations preclude the use of 4:2:2 P @ HL and where limited additional processing is anticipated.

Furthermore, for digital terrestrial reception:

****

By direction of the MISB and as ratified by the GSMC-ISMC, the following paragraph is temporarily removed (suspended) from mandated Standard status, pending further review by the MISB and the ISMC. Significant concerns have arisen in the commercial television technology community with regards to the technical viability of the 8VSB RF Modulation standard specified in ATSC Doc. A/53. Therefore, it is prudent to suspend mandated implementation of this standard until further notice.

(1) Within the United States, the DoD/IC/USIGS standard for receivers shall be in compliance with the Federal Communication Commission, "Fourth Report and Order," (24 December 1996) which adopted (except for Annex A, Section 5.1.2 Compression format constraints - including Table 3) ATSC Doc. A/53 as the United States Digital Television Standard.

(GSMC-ISMC, 12 August 1999 – Approved)

****

(2) Receivers for use in other world regions will need to consider terrestrial broadcast standards for that area. Furthermore, to promote <u>universal interoperability</u>, DoD/IC/USIGS high definition advanced television and motion imagery **RECEIVING** systems must be able to decode, process and display all of the diverse sampling structures and temporal rates within the MPEG-2 High Level profiles specified above, where the systems may either display the received signal in its native format or the signals may be re-formatted to the highest common progressive format supported by the system. The following specific motion imagery sampling formats and temporal rates are noted as a mandatory sub-set under the broader MPEG-2 High Level receiver umbrella:

> 1920 x 1080, frame rates 30p, 30p/1.001, 30i, 30i/1.001, 25p, 25i, 24p;
> 16:9 Aspect Ratios

> 1280 x 720, frame rates 60p, 60p/1.001, 50p, 30p, 30p/1.001, 25p, 24p;
> 16:9 Aspect Ratios

> 720 x 576, frame rates 50p, 25p, 25i, 24p;
> 16:9 or 4:3 Aspect Ratios

> 720 x 480 (483), frame rates 60p, 60p/1.001, 30p, 30p/1.001, 30i, 30i/1.001, 24p, 24p/1.001; 16:9 or 4:3 Aspect Ratios

> 640 x 480, frame rates 60p, 60p/1.001, 30p, 30p/1.001, 24p, 24p/1.001; 4:3 Aspect Ratios

> 9723 Note 1: For future enhancement and migration options, the following additional formats should be decoded by DoD/IC/USIGS MP@HL receiving systems, where the systems may either display the received signal in its native format or the signals may be re-formatted to the highest common progressive format supported by the display (See SMPTE 274-1998):

> 1920 x 1080, frame rates 60p, 60p/1.001, 50p; 16:9 Aspect Ratios

Furthermore, DoD/IC/USIGS high definition advanced television and motion imagery **ORIGINATION, ACQUISITION, PRODUCTION, MANIPULATION**, and or **PROCESSING** systems must generate at least one of the following sampling formats and its associated temporal rates:

For High Definition applications:

1280 x 720, frame rates 60p, 50p, 30p, 25p, 24p; 16:9 Aspect Ratios

1920 x 1080, frame rates 30p, 25p, 24p; 16:9 Aspect Ratios

9723 Note 2: For future enhancement and migration options, 1080 progressive scan formats (50p/60p) are included as future objectives for high definition motion imagery applications, but the MISB notes that 1080 50p/60p systems are not yet commercially available. Therefore, 1080 50p/60p systems are not mandated under this VISP profile. The MISB will continue to periodically evaluate the availability of 1080 progressive scan format systems for future

9723 Note 3: Dual mode interlaced and progressive scan systems are authorized under this MISP profile, provided that for DoD/IC/USIGS applications, 1) only the progressive scan mode shall be used and 2) provided that the progressive scan mode is derived from a native progressive capture and is not derived from an interlaced image capture.

For Standard Definition applications:

720 x 576, frame rates 50p, 25p, 25i, 24p; 16:9 or 4:3 Aspect Ratios

720 x 480 (483), frame rates 60p, 30p, 30i, 30i/1.001, 24p;
    16:9 or 4:3 Aspect Ratios

640 x 480, frame rates 60p, 50p, 30p, 25p, 24p; 4:3 Aspect Ratios

9723 Note 4: 720 horizontal pixels are the standard width for DoD/IC/USIGS standard and enhanced definition program origination and processing. DoD/IC/USIGS systems shall not originate or process imagery content using 704 horizontal pixels.

(VWG, 25 February 1998 - Approved As Amended) (ISMC, 6 March 1998 - Approved)

3.4.3   STANDARD 9703 - Digital Motion Imagery, Uncompressed Baseband Signal Transport and Processing

SMPTE 292M high definition (1.5 Gb/s Bit-Serial Interface) shall be the uncompressed baseband signal transport and processing DoD/IC/USIGS STANDARD for digital motion imagery, audio and metadata origination, system interface, production/analysis center processing and manipulation.

9703 Note 1:   The "Connector Type" specification given in SMPTE 259M, Section 4, or 292M recommends a preferred connector (BNC) and cable type (coax). For DoD/IC/USIGS users, such physical connections and cable types can be considered to be Recommended Practices, not Standards. (Flexibility to use connectors other than BNC is given to accommodate operational directives, which do not allow BNC connectors in aircraft systems.)

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)

(VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 - Approved) (VWG, 8 June 1999 – Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended)

3.5   Low Spatial/Temporal Motion Imagery

3.5.1   STANDARD 9706 - Motion Imagery Still Frames

The National Imagery Transmission Format (NITF 2.1) shall be the DoD/IC/USIGS STANDARD for digital still images that have been extracted from video image sequences. Once an image has been captured for individual still image processing, exploitation and dissemination; the image is no longer considered to be video and is therefore not subject to this Motion Imagery Standards Profile (but must meet all NITF

Furthermore, still images should be extracted from full resolution bit-serial interface video streams, with direct conversion and storage into NITF image formats (using no transitional analog processing steps).

Furthermore, still images may be directly extracted from MPEG-2 digital files provided there are no transitional analog processing steps.

(VWG, 16 Jan 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (GSMC-ISMC, 6 March 1998 – Approved As Amended)

3.6   Metadata

3.6.1   STANDARD 9708 - Imbedded Time Reference for Motion Imagery Systems

SMPTE 12M-1999, commonly known as SMPTE time code, shall be the DoD/IC/USIGS STANDARD for time annotation and imbedded time references for motion imagery systems.

Furthermore, within SMPTE 12M, Drop Frame Time Code shall be used for 60/1.001, 30/1.001, 24/1.001 frames per second (FPS) systems. Non-Drop Frame Time Code shall be used for 60, 50, 30, 25, and 24 FPS systems.

SMPTE 309M shall be the DoD/IC/USIGS STANDARD for precision time and date imbedding into SMPTE 12M time code data streams.

Furthermore, within SMPTE 309M, DoD/IC/USIGS users will use the Modified Julian Date (MJD) (Y2K compliant) date encoding format and Universal Coordinated Time (UTC) as the time zone format.

(VWG, 26 March 1997 - Adopted as Amended) (ISMC, 12 June 1997 - Approved)
(VWG, 25 February 1998 - Language Editorially Revised) (ISMC, 6 March 1998 - Approved)

3.6.2   STANDARD 9711 - Intelligence Motion Imagery Index, Geospatial Metadata

The VWG Metadata Sub-Group, "Core Video Metadata Profile," Version 1.0, 14 March 1997 is the DoD/IC/USIGS RECOMMENDED PRACTICE for analog video intelligence Geospatial Metadata. This RP for legacy analog video was developed to capture and transmit metadata over analog video services to take advantage of existing metadata previously only available in telemetry. The intention is that when analog motion imagery systems are replaced by digital systems that they will use the more extensible Metadata Dictionary and Encoding described by STANDARDS 9713, 9716-

(VWG, 26 March 1997 - Adopted) (ISMC, 12 June 1997 - Approved) (VWG, 8 June 1999 – Language Editorially Revised) (GSMC-ISMC, 12 August 1999 – Approved as Amended)

9711 Note 1: This Profile has been nominated by the MISB for candidate harmonization with the SMPTE " Metadata Dictionary" Standard

9711 Note 2: DoD/IC/USIGS users may begin system development activities using this Core Geospatial Metadata, with the understanding that metadata parameters may change depending on negotiations and coordination with SMPTE and commercial video equipment manufacturers. The expectation is that the Geospatial metadata forms the initial core of the DoD/IC/USIGS requirement set for the broader digital "Motion Imagery Metadata Dictionary" Standard, and once part of the broader standard, will provide significantly enhanced applicability and broad, universal interoperability with commercial index, archive, and Geospatial motion imagery systems. The new SMPTE standard should provide a single standard for both DoD/IC/USIGS and commercial systems.

(VWG, 16 January 1997 - Approved for Study)

- -

9711 Note 3: The Core Video Metadata Profile elements have been incorporated into the more extensive VWG "Metadata Dictionary and Encoding" Version 1.0 document.

However, it is expected that the analog Core Motion Imagery Metadata Profile will continue as long as legacy analog motion imagery systems are still fielded.

(VWG, 8 June 1999 – Language Editorially Revised)

3.6.3 STANDARD 9712 - Intelligence Motion Imagery Index, Content Description Metadata (Dynamic Metadata Dictionary Structure and Contents)

SMPTE 335M-2001, *Metadata Dictionary Structure*, SMPTE RP210.3-2001, *SMPTE Metadata Dictionary Contents,* and SMPTE EG37-2001, *Node Structure For the SMPTE Metadata Dictionary*, formerly known as the Intelligence Video Index (Video Metadata Dictionary), comprise the DoD/IC/USIGS STANDARD for the definition and identification of metadata elements encoded in digital motion imagery products.

All new DoD/IC/USIGS motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into uncompressed digital motion imagery bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 16 Jan. 1997 - Approved for Study; VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval) (MISB, 27 July 2000 – SMPTE Standard Recommended)(02 November 2000 GSMC-ISMC Approved)(MISB, 24 May 2001, Replaced 210.2 by 210.3)

3.6.4 STANDARD 9713 – Data Encoding Using Key-Length-Value

SMPTE 336M-2001, *Data Encoding Protocol Using Key-Length-Value,* is the DoD/IC/USIGS STANDARD protocol for encoding data essence and metadata (such as 9712) into Motion Imagery streams, files, and associated systems.

(VWG, 16 Jan. 1997 - Approved for Study; VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval) (MISB, 27 July 2000 – SMPTE Standard Recommended)(02 November 2000 GSMC-ISMC Approved)

3.6.5 STANDARD 9714 - Time Code Embedding

Digital Vertical Interval Time Code (D-VITC) shall be imbedded on digital video line 9 of all ITU-R BT.601-5 Component (4:2:2) and bit-serial interface systems. Users may implement LTC for internal processing (such as in tape recorders) provided D-VITC is always forwarded to the next processing element on digital video line 9.

Furthermore, SMPTE Ancillary Time Code (embedded in the bit-serial interface Ancillary data space) may be used instead of D-VITC, provided such time code data is part of other metadata delivered by the ancillary data stream.

Date and Time Zone information defined by SMPTE 309M shall be used to achieve Year 2000 (Y2K) compliance by all DoD/IC/USIGS systems.

(VWG, 26 March 1997 - Approved for Study; VWG, 19 November 1997- Language Revised;) (VWG, 8 June 1999 – Study Completed; Recommended to GSMC-ISMC for Approval) (GSMC-ISMC, 12 August 1999 – Approved)

3.6.6   STANDARD 9715 - Time Reference Synchronization

Universal coordinated time (UTC, also known as "Zulu"), clock signals shall be used as the universal time reference for DoD/IC/USIGS SMPTE 12M time code systems, allowing systems using time code to accurately depict the actual Zulu time of day of motion imagery acquisition / collection / operations.

Furthermore, when DoD/IC/USIGS "original video acquisition" motion imagery sequences are used as sources for editing onto new "edit master" sequences, the "edit master" sequence may have a new, continuous time code track. The time code for the new sequence should reflect the "document date" of the new motion imagery product.

Furthermore, Global Positioning System time, corrected to UTC, is the Recommended Practice for the source of time data.

(VWG, 19 November 1997, Adopted as Amended)
(VWG, 25 February 1998 - Language Revised) (ISMC, 6 March 1998 - Approved)

3.6.7   STANDARD 9716 – Packing KLV Packets into SMPTE 291 Ancillary Data Packets

The MISB document "Packing KLV Packets into SMPTE 291 Ancillary Data Packets", Version 1.0, October 1999, is the DoD/IC/USIGS STANDARD for the encoding of metadata elements into Serial Digital Interface (SDI) SMPTE 291M ancillary data packets.

Note: When the SMPTE Recommended Practice "Packing KLV Packets into SMPTE 291M Ancillary Data Packets" has been approved by SMPTE and has been evaluated by the MISB as meeting DoD/IC/USIGS requirements, the SMPTE RP will become the DoD/IC/USIGS STANDARD for all motion imagery systems.

All new DoD/IC/USIGS motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into uncompressed digital motion imagery bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - Approved for Study, VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval)

3.6.8   RECOMMENDED PRACTICE 9717 - Packing KLV Packets into MPEG-2 Systems Streams

SMPTE RP 217-2001, *Nonsynchronized Mapping of KLV Packets into MPEG-2 System Streams,* is the DoD/IC/USIGS Recommend Practice for the non-synchronous encoding of metadata elements into MPEG-2 Systems Streams.

Note: To be MISP compliant, KLV metadata in BOTH the Transport Stream and Program Stream must be identified by the registered format_identifier 0x4B4C5641 ("KLVA"). SMPTE RP 217-2001 states that 0x4B4C5641 is the format_identifier to be used for the Transport Stream, but 0x4B4C5641 or "some other descriptor" may be used for the Program Stream.

ISO/IEC 13818-1:2000/FPDAM 1: "Information technology -- Generic coding of moving pictures and associated audio information: Systems, AMENDMENT 1: Carriage of metadata over ISO/IEC 13818-1 streams" (DRAFT) is authorized for DoD/IC/USIGS use but is not mandated for the synchronous encoding of metadata for exchange of motion imagery and metadata files for collaboration of production work in progress among analysts; storage of work in progress for access by multiple users; and permanent archive of all contributions to a finished work.

All new DoD/IC/USIGS motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into compressed digital motion imagery bit streams (MPEG-2) as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - Approved for Study, VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approved) (MISB, 11 October 2001 – Submitted for Approval)(Revised 29 November 2001 for GSMC/ISMC approval)

3.6.9   STANDARD 9718 – Packing KLV Packets into AES3 Serial Digital Audio Streams

SMPTE 355M-2001 (previously SMPTE RP 213-2000), *Format for Non-PCM Audio and Data in AES3 – KLV Data Type,* is the DoD/IC/USIGS STANDARD for the encoding of metadata elements into AES3 data streams.

All new DoD/IC/USIGS motion imagery systems that incorporate metadata shall use these standards for digital encoding of metadata into AES3 audio bit streams as a replacement for the closed captioning of metadata in analog legacy systems [9709]. These digital systems shall NOT encode metadata as digital closed caption information.

(VWG, 26 March 1997 - Approved for Study, VWG, 19 November 1997- Language Revised) (VWG, 8 June 1999 – Language Revised) (VWG, 20 October 1999 - Adopted; Recommended to GSMC-ISMC for Approval) (24 February 2000 – GSMC-ISMC Approval) (MISB, 27 July 2000 – SMPTE RP Recommended) (02 November 2000 GSMC-ISMC Approved)

3.6.10 RECOMMENDED PRACTICE 0101 – Use of MPEG-2 System Streams in Digital Motion Imagery Systems

MISP RP 0101 shall be the recommended practice for use of MPEG-2 system streams in motion imagery systems.

(7 February 2001 - MISB Adopted; 01 March 2001 GSMC-ISMC Approved)

3.6.11 RECOMMENDED PRACTICE 0102 – Security Metadata Universal Set for Digital Motion Imagery

MISP RP 0102 shall be the recommended practice for use of security metadata in MPEG-2 digital motion imagery applications.

(7 February 2001 - MISB Adopted; 01 March 2001 GSMC-ISMC Approved)

3.6.12 RECOMMENDED PRACTICE 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery

This Recommended Practice (RP) defines a timing reconciliation metadata set to correct (reconcile) the original capture time of metadata with the User Defined Time Stamp stamped timecode usually associated with the capture time of the digital motion imagery or audio essence. Timing reconciliation metadata is not required if the application using the metadata does not depend on the amount of timing error or uncertainty between the metadata capture and the video or audio essence capture.

(MISB, 24 May 2001 – Submitted for Approval)

3.6.13 Engineering Guideline 0104 - Basic Predator KLV Metadata

Engineering Guideline (EG) 0104 defines the basic and geospatially adjusted Predator UAV (Unmanned Aerial Vehicle) metadata to be encoded into a standard SMPTE KLV Metadata Universal Metadata Sets. This EG provides direction on the creation of a standard metadata sets for reliable exchange of Predator closed caption (CC) data among digital motion imagery systems.

The scope of this EG is strictly limited to metadata that originates as closed caption metadata in analog video from the Predator UAV.   Analog video and closed caption metadata are legacy systems that may continue to be used during the transition to all-digital sensors and information infrastructures.   This EG facilitates that transition only and does not constitute an approved end-system implementation.

(MISB, 24 May 2001 – Submitted for Approval)

3.6.14 STANDARD 0107 - Bit and Byte Order for Metadata in Motion Imagery Files and Streams

The MISB STANDARD 0107, "Bit and Byte Order for Metadata in Motion Imagery Files and Streams", 11 October 2001, defines the selection of big-endian for bit and Byte order (msb-first and MSB-first). This is applicable only to KLV metadata encoding. Bit and Byte order of essence is not affected.

(MISB, 11 October 2001 – Submitted for Approval by Metadata Working Group)

3.7   File Formats

3.7.1   RECOMMENDED PRACTICE 0106 – Advanced Authoring Format

Advanced Authoring Format (AAF), Advanced Authoring Format Object Specification, V 1.0, AAF Association, 9 June 2000, is authorized for DoD/IC/USIGS use but is not mandated for the exchange of motion imagery and metadata files for collaboration of production work in progress among analysts; storage of work in progress for access by multiple users; and permanent archive of all contributions to a finished work.

(MISB, 24 May 2001 – Submitted for Approval)

3.7.2   RECOMMENDED PRACTICE 0107 – Material Exchange format

Material Exchange Format (MXF), Version 0.7, Release 4, Pro-MPEG Forum, 10 April 2001, is authorized for DoD/IC/USIGS use but is not mandated for interchange of motion imagery for single programs, finished material between an archive and user and distribution of tailored sections of a finished work to satisfy a user's specific request.

(MISB, 24 May 2001 – Submitted for Approval)

APPENDIX A – EMERGING STANDARDS, INTEROPERABILITY PROFILES, RECOMMENDED PRACTICES, AND ENGINEERING GUIDELINES FOR DoD/IC/USIGS IMPLEMENTATIONS

Note: MISP Studies that have been completed and approved as standards, recommended practices, or engineering guidelines are moved to Section 2.0.

STUDY 9801 – MPEG-4

Evaluate and/or support development of the emerging ISO/IEC 14496 (commonly known as MPEG-4) compression format standard for DoD/IC/USIGS systems for finished product dissemination applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9802 – MPEG-7

Evaluate and/or support development of the emerging MPEG-7 standard for DoD/IC/USIGS applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9803 – Serial Data Transport Interface

Evaluate the emerging Serial Data Transport Interface (SDTI) standard for DoD/IC/USIGS applications.

(VWG, 19 Nov 1997 - Approved for Study; VWG, 8 June 1999 – Language Revised) (MISB, 7 February 2001 – SMPTE 305.2M-2000 Accepted; Moved to Section 2.0)

STUDY 9804 – Colorimetry

Evaluate existing and/or support development of emerging standards for motion imagery colorimetry for DoD/IC/USIGS applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9805 – Standard Motion Imagery Test Materials

Evaluate existing and/or support emerging standards for motion imagery test materials, including standard definition and high definition sequences, for DoD/IC/USIGS applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9806 – Motion Imagery Concatenation Image Quality Protection

Evaluate and/or support development of emerging standards for systems that reduce or eliminate motion imagery encoding concatenation errors for DoD/IC/USIGS

Three draft SMPTE standards relevant to this Study are in technical review by SMPTE Technical Committee N26, File Management and Networking Technology: "The MPEG-2 Re-Coding Data Set", "Transporting MPEG-2 Re-Coding Information through 4:2:2 Component Digital Interfaces", "Transporting MPEG-2 Re-Coding Information through High-Definition Digital Interfaces". COTS implementations of these draft standards are already available.

Once SMPTE adopts the family of MPEG-2 re-coding standards and they have been evaluated by the MISB as meeting DoD/IC/USIGS requirements, the SMPTE MPEG-2 re-coding Standards will become a DoD/IC/USIGS STANDARD for the transfer of re-coded MPEG-2 digital waveforms for motion imagery systems.

(VWG, 19 Nov 1997 - Approved for Study; VWG, 8 June 1999 – Language Revised)

STUDY 9807 – Motion Imagery Quality Metrics

Evaluate and/or support development of emerging standards for systems based on "Just Noticeable Difference" (JND) techniques for automatic motion imagery image quality measurements, for DoD/IC/USIGS applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9808 – Still Imagery Derived from Video Motion Imagery

Evaluate and/or support development of emerging standards such as NITF 2.1, NSIF, and or BIIF, for the carriage of still imagery derived from motion imagery and for the future carriage of native motion imagery segments and related metadata.

Note: Under this Study NIMA has developed the capability to directly capture still images from MPEG-2 streams and output them in TIFF or NITF formats on the Windows NT platform. This prototype GFE software is available for use by Government agencies from the NIMA Motion Imagery Office. COTS versions of this software are also available. These software products significantly preserve image quality as compared to traditional MPEG-2 decompression to base band video and subsequent frame grabs and storage to NITF file formats.

(VWG, 19 Nov 1997 - Approved for Study; VWG, 8 June 1999 – Language Revised)

STUDY 9809 – Audio Interchange

Evaluate audio standards for DoD/IC/USIGS applications. Initial study activities will include standards such as AES-3, MPEG-2 Audio, Dolby AC3.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9810 – Low Bit-Rate Motion Imagery

Evaluate low bit-rate motion imagery for DoD/IC/USIGS applications.

(VWG, 19 Nov 1997 - Approved for Study)

STUDY 9903 - MPEG-2 Embedded Subheader

Develop concept and detailed technical implementation to embed the information content of the NITF header / subheader at a defined location in an MPEG-2 Program Stream (PS). This study includes preparation of format specifications

for this information. The resulting program stream must be fully interoperable with commercial off-the-shelf MPEG-2 decoders and viewers.

(VWG, 8 June 1999 - Approved for Study)

STUDY 9904 - NITF Support for Motion Imagery

Develop RFC for addition of MPEG-1 and MPEG-2 (future growth: MPEG-4) support to the NITFS. This study includes preparation of format specifications. The resulting NITF files must be interoperable (with software modifications to process the motion imagery content) with existing systems that support NITF.

(VWG, 8 June 1999 - Approved for Study)

STUDY 9905 – Concise KLV Encoding for Bit Efficiency

Evaluate and/or support development of emerging standards for the encoding of metadata elements using a concise form of the KLV standard data protocol.

(VWG, 8 June 1999 – Approved for Study; Editorially revised, VWG, 20 October 1999) (MISB 7 February 2001 – Study cancelled because concise encoding of KLV is now present in the SMPTE 336M standard through the use of Local Sets, Variable Length Packs, and Labels.)

STUDY 9906 – Segmentation and Re-assembly of KLV Packets

Evaluate and/or support development of emerging standards for segmentation and re-assembly (SAR) of large metadata values when transport systems do not provide this service.

(VWG, 20 October 1999 – Approved for Study) (MISB 7 February 2001 – Study cancelled because SAR is the responsibility of the transport protocol and not the encoding protocol.)

STUDY 0002 – MPEG and KLV Interoperability

Provide proper guidance as to which MPEG transport layer streams to use for different DoD/IC/USIGS motion imagery applications. Assure that KLV packs into the MPEG streams with global interoperability.

(MISB, 27 July 2000 - Approved for Study)

STUDY 0003 – Advanced High Definition Television

Motion Imagery System Matrix Level 14 (MISM-L14), Uncompressed Advanced High Definition Motion Imagery, should be refined to reflect technology in the laboratory. Examine compressed and uncompressed Advanced HD motion imagery taking into account multispectral sensor outputs.

Note 1: Only PROGRESSIVE SCAN formats are authorized for advanced high definition DoD/IC/USIGS motion imagery acquisition applications (systems used to originate, acquire, produce, process, manipulate, exploit, store, archive and disseminate motion imagery in support to imaging applications, including (but not limited to) Intelligence, Reconnaissance, and Surveillance).

(MISB, 27 July 2000 - Approved for Study)

STUDY 0004 - Motion Imagery Security, Authentication, and Encryption

Evaluate and/or support development of emerging standards in security/ releasability marking, digital signatures, digital watermarking, steganography, and encryption as applied to motion imagery and associated metadata for DoD/IC/USIGS applications.

(MISB, 27 July 2000 - Approved for Study)

STUDY 0105 – Motion Imagery Sensor/Collection Metadata

Enumerate digital metadata to be captured from sensors and vehicle subsystems on generic unmanned vehicles. Research available documentation from unmanned air vehicle (UAV), unmanned combat air vehicle (UCAV), unmanned ground vehicle (UGV), unmanned subsurface vehicle (UUV), and fixed-site surveillance sources. Focus of this study shall be on all metadata that directly supports the advanced collection, processing, exploitation, storage, retrieval, distribution, and use of motion imagery. Coordinate with ongoing UAV, UCAV, UGV, UUV, and fixed-site surveillance programs to compile a Recommended Practice describing a metadata schema to be embedded into digital motion

(MISB, 7 February 2001 - Approved for Study)(MISB, 24 May 2001, Changed Title)

STUDY 0106 – Advanced File Formats

Evaluate and/or support development of emerging standards for advanced digital media file formats for the exchange of motion imagery and metadata files across systems and applications.

(01 March 2001 GSMC-ISMC Approved for Study)

STUDY 0108 – Metadata for Scathe View

Evaluate and/or support development of emerging standards for Scathe View Metadata.

(11 October 2001 MISB Approved for Study)

STUDY 0109 - Precision Engagement Metadata

Evaluate and/or support development of emerging standards for Precision Engagement Metadata.

(11 October 2001 MISB Approved for Study)

APPENDIX B - REFERENCES AND BIBLIOGRAPHY

1. ATSC Doc. A/53, *Advanced Television Standard*, 16 September 1995.

2. Code of Federal Regulations, Title 47, Chapter 1, Part 15, Section 119 (47CFR15.119), *Closed Caption Decoder Requirements for Television Receivers*, Revised 1 October 1998.

3. DoD Directive 5105.60, *National Imagery and Mapping Agency (NIMA),* October 11, 1996.

4. *DoD Joint Technical Architecture (JTA),* Version 4.0, 2 April 2001.

5. EIA, *Recommended Practice for Advanced Television Closed Captioning*, R-4.3 subcommittee, draft, July 1, 1994.

6. EIA-608, *Recommended Practice for Line 21 Data Service*, September 1994.

7. EIA-708-A, *Digital Television (DTV) Closed Captioning*, 23 November 1998.

8. ETR 211 Ed. 2, *Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)* 1997.

9. ETR 162, *Digital broadcasting systems for television, sound, and data services: Allocation of Service Info. (SI) codes for Digital Broadcasting (DVB) systems*, 1995.

10. ETS 300 468, *Digital broadcasting systems for television, sound, and data services: Specification for Service Information (SI) in Digital Video Broadcasting (DVB) systems*, 1994 (also known as DVB SI).

11. ETS 300 743, *Digital Video Broadcasting (DVB); DVB subtitling*, 1996.

12. FCC Fourth Report and Order, *Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service*, Adopted 24 December 1996 (Released 27 December 1996).

13. IEEE Std 1394-1995, *Standard for a High Performance Serial Bus.*

14. ISO/IEC 13818-1, *Information technology - Generic coding of moving pictures and associated audio information, Part 1: Systems*, 2000 (also known as MPEG-2 Systems).

15. ISO/IEC 13818-2, *Information technology - Generic coding of moving pictures and associated audio information, Part 2: Video*, 2000 (also known as MPEG-2 Video).

16. ISO/IEC 13818-3, *Information technology - Generic coding of moving pictures and associated audio information, Part 3: Audio*, 1998 (also known as MPEG-2 Audio).

17. ISO/IEC 13818-4, *Information technology - Generic coding of moving pictures and associated audio information, Part 4: Compliance Testing*, 1998 (also known as MPEG-2 Compliance).

18. ISO/IEC 13818-6, *Information technology - Generic coding of moving pictures and associated audio information, Part 6: Extension for Digital Storage Media Command and Control*, 1996 (also known as MPEG-2 DSM-CC).

19. ISO/IEC 13818-9, *Information technology - Generic coding of moving pictures and associated audio information, Part 9: Real-time Interface Specification*, 1996 (also known as MPEG-2 RTI).

20. ISO/IEC 14496-2, *Coding of audio-visual objects, Part 2: Visual, 1999* (also known as MPEG-4).

21. ITU-R BT.601-5, *Studio encoding parameters for digital television for standard 4:3 and wide-screen 16:9 aspect ratios*, 1995.

22. ITU-R BT.1208, *Video coding for digital terrestrial television broadcasting*.

23. MIL-STD-2500B, *National Imagery Transmission Format Version 2.1 for the National Imagery Transmission Format Standard*, 22 August 1997; Change Notice 1, 2 October 1998.

24. SMPTE 12M-1999, *Television, Audio and Film - Time and Control Code.*

25. SMPTE 170M-1999, *Television - Composite Analog Video Signal - NTSC for Studio Applications.*

26. SMPTE 259M-1997, *Television - 10-Bit 4:2:2 Composite and 4 fsc Composite Digital Signals – Serial Digital Interface.*

27. SMPTE 274M-1998, *Television - 1920 x 1080 Scanning and Interface.*

28. SMPTE 291M-1998, *Television - Ancillary Data Packet and Space Formatting.*

29. SMPTE 292M-1996, *Television - Bit-Serial Digital Interface for High-Definition Television Systems.*

30. SMPTE 293M-1996, *Television - 720 x 483 Active Line at 59.94-Hz Progressive Scan Production - Digital Representation.*

31. SMPTE 294M-1997, *Television - 720 x 483 Active Line at 59.94-Hz Progressive Scan Production - Bit-Serial Interfaces.*

32. SMPTE 295M-1997, *Television - 1920 x 1080 50-Hz - Scanning and Interface.*

33. SMPTE 296M-2001, *Television - 1280 x 720 Progressive Image Sample Structure - Analog and Digital Representation and Analog Interface.*

34. SMPTE 297M-1997, *Television - Serial Digital Fiber Transmission System for ANSI/SMPTE 259M Signals.*

35. SMPTE 305.2M-2000, *Serial Data Transport Interface (SDTI).*

36. SMPTE 309M, *Transmission of Date and Time Zone Information in Binary Groups of Time and Control Code.*

37. *USIGS Technical Architecture*, Revision A, 26 January 1999.

38. SMPTE 335M-2001, *Metadata Dictionary Structure*.

39. SMPTE 336M-2001, *Data Encoding Protocol Using Key-Length-Value*.

40. SMPTE 355M - 2001, *Format for Non-PCM Audio and Data in AES3 – KLV Data Type*.

41. SMPTE RP210.3-2001, *SMPTE Metadata Dictionary Contents*.

42. SMPTE EG37-2001, *Node Structure For the SMPTE Metadata Dictionary*.

43. ITU-R BT.1358, *Studio Parameters of 525 and 625 Line Progressive Scan Television Systems*, 1998.

44. Material Exchange Format (MXF), Version 0.7, Release 4, Pro-MPEG Forum, 10 April 2001.

45. Advanced Authoring Format Object Specification, V 1.0, AAF Association, 9 June 2000.

46. MISB Standard 9716, "Packing KLV Packets into SMPTE 291 Ancillary Data Packets", Version 1.0, October 1999.

47. MISB Standard 9717, "Packing KLV Packets into MPEG-2 Systems Streams", Version 1.0, October 1999.

48. MISB Recommended Practice RP 0101," Use of MPEG-2 System Streams in Digital Motion Imagery Systems", 28 Feb 2001.

49. MISB Recommended Practice RP 0102.1, "Security Metadata Universal Set for Digital Motion Imagery", 11 October 2001.

50. MISB Recommended Practice RP 0103.1, "Timing Reconciliation Universal Metadata Set for Digital Motion Imagery", 11 October 2001.

51. MISB Engineering Guideline EG 0104.1, "Predator UAV Basic Universal Metadata Set", 11 October 2001.

52. MISB Standard 0107, "Bit and Byte Order for Metadata in Motion Imagery Files and Streams", 11 October 2001.

53. ISO/IEC 13818-1:2000/FPDAM 1: "Information technology -- Generic coding of moving pictures and associated audio information: Systems, AMENDMENT 1: Carriage of metadata over ISO/IEC 13818-1 streams" (DRAFT).

54. SMPTE RP 217-2001, *Nonsynchronized Mapping of KLV Packets into MPEG-2 System Streams*.

55. IEEE 1394-1995, *IEEE Standard for High Performance Serial Bus - Firewire 1995*.

APPENDIX C – ACRONYMS AND ABBREVIATIONS

AES3 – Audio Engineering Society 3

ANSI – American National Standards Institute

ATM – Asynchronous Transfer Mode

ATSC – Advanced Television Systems Committee

ATV – Advanced Television

AVI – Audio / Video Interleaved

BIIF – Basic Image Interchange Format

BNC – British National Connector

CFR – Code of Federal Regulations

COTS - Commercial Off-the-Shelf

DoD – Department of Defense

DV – Digital Video

DVB – Digital Video Broadcasting

DVD – Digital Versatile Disk; Digital Video Disk

D-VHS – Digital VHS

D-VITC – Digital VITC

EBU – European Broadcast Union

ED – Enhanced Definition

EIA – Electronics Industries Association

ELT – Electronic Light Table

EO – Electro-optical

ETR – European Telecommunications Report

ETS – European Telecommunications Standard

FCC – Federal Communications Commission

FOV – Field of View

FPS – Frames Per Second

GFE – Government Furnished Equipment

GPS – Global Positioning System

GSMC – Geospatial Standards Management Committee

HD – High Definition

HDTV – High Definition Television

HL – High Level

IC – Intelligence Community

IEC – International Electrotechnical Commission

IEEE – Institute of Electrical and Electronics Engineers

IOC – Initial Operational Capability

IPL – Image Product Library

ISDN – Integrated Services Digital Network

ISMC – Imagery Standards Management Committee

ISO – International Organization for Standardization

ITU – International Telecommunication Union

ITU-R – International Telecommunication Union – Radiocommunications Sector

JND – Just Noticeable Difference

JTA – Joint Technical Architecture

KLV – Key-Length-Value

LTC – Longitudinal Time Code

MASINT – Measurement and Signature Intelligence

MIL-STD – Military Standard

MIPO – Motion Imagery Program Office

MISB – Motion Imagery Standards Board

MISM-L – Motion Imagery Systems Matrix -Level

MISM – Motion Imagery Systems Matrix

MISP – Motion Imagery Standards Profile

MJD – Modified Julian Date

ML – Main Level

MP – Main Profile

MPEG – Moving Picture Experts Group

MTI – Moving Target Indicator

NATO – North Atlantic Treaty Organization

NIIRS – National Imagery Interpretation Rating Scale

NSIF – NATO Secondary Imagery Format

NTSC – National Television Standards Committee

OC-3 – Fiber Optic Communications Standard (155 Mbps)

OC-12 - Fiber Optic Communications Standard (655 Mbps)

PAL – Phase Alternate Line Format

POTS – "Plain Old Telephone Service"

PS – Program Stream

QSIF – Quarter SIF (176x120 pixels)

RFC – Request for Change

RP – Recommended Practice

SAR – Segmentation and Re-assembly

SAR – Synthetic Aperture Radar

SD – Standard Definition

SDI – Serial Digital Interface

SDTI – Serial Data Transport Interface

SECAM – System Electronique Couleur Avec Memoire

SIF – Standard Image Format (352x240 pixels)

SIGINT – Signals Intelligence

SMPTE – Society of Motion Picture and Television Engineers

STANAG – Standardization Agreement (NATO)

S-VHS – Super Vertical Helical Scan

T-1 – Telecommunications Link Standards (1.5 Mbps)

T-3 - Telecommunications Link Standards (45 Mbps)

TBD – To be Determined

TIFF – Tagged Image File Format

TS – Transport Stream

UAV – Unmanned Aerial Vehicle

USIGS – United States Imagery and Geospatial Information Service

UTA – USIGS Technical Architecture

UTC – Coordinated Universal Time

UVID – Universal Video Index and Dictionary

VHS – Vertical Helical Scan

VISP – Video Imagery Standards Profile

VITC – Vertical Interval Time Code

VWG – Video Working Group

Y2K – Year 2000

APPENDIX D – REVISION RECORD

Date on Document	Version Number	Notes/Status
16 Jan 1997	0.96	Version 0.96 – First VWG VISP document under configuration control. 16 Jan 97 document plus 30-day provisional adoption items. Submitted to VWG and adopted with agreed changes on 26 Mar 97.
26 Mar 1997	0.97	Final baseline version as adopted by VWG (includes agreed changes from 26 Mar 97). Submitted to ISMC for approval. Approved by ISMC on 12 Jun 97 with agreed minor changes.
12 Jun 1997	1.00	Final ISMC approved baseline version (includes agreed minor changes from 12 Jun 97).
26 Sep 1997	1.10	Incorporates the following changes approved by the ISMC on 26 Sep 1997: V97-001 – Video Systems Matrix update - Section 4.0 – Recommended Practice 9720 V97-002 – Change of document title to: "Video Imagery Standards Profile" (Includes editorial changes and reorganization to align with other DoD/IC/USIGS standards documents)
19 Nov 1997	1.20	Incorporates the following changes approved by the VWG on 19 Nov 1997: V98-001 – Updates to and adoptions of Standard 9715 (Time Reference Synchronization), Updates to and adoptions of Standard 9723 (Advanced Television). Updates to and adoption of Video Systems Matrix RP 9720a (HD).
7 Jan 1998	1.21	Returns Standard 9723 (Advanced Television) to Emerging status and RP 9720a (HD) to Study status pending formal GSMC-ISMC approval; incorporates Explanatory/editorial changes. Note that 1.21 is the reference baseline for JTA 2.0
25 Feb 1998	1.22	Incorporates revisions to 1.2 (based on 60 days Comments Period); incorporates explanatory/editorial changes. Incorporates changes from 25 Feb VWG.
6 Mar 1998	1.3	GSMC-ISMC Approved As Amended.

REVISION RECORD (continued)

Date on Document	Version Number	Notes/Status

8 June 1999	1.4	Incorporates the following changes provisionally approved by the VWG on 20 Jan 1999 and with language revised by VWG on 8 June 1999:
		1) Addition of a DoD/IC/USIGS Video Imagery Migration Objective section to Chapter 1.
		2) Movement of 9714, Time Code Embedding, from Study to Standard status.
		3) Temporary suspension of a portion of 9723 (FCC Fourth Report and Order).
		4) Revision of Metadata Studies 9712, 9713, 9716, 9717, 9718 to reflect recent changes in draft SMPTE standards.
		5) New Studies 9903, 9904, 9905 for NITF wrapper for motion imagery, MPEG-2 PS subheader, and Concise KLV Encoding.
		6) Extensive revision of Recommended Practice 9720 to include addition of Enhanced Definition as a new VSM band with other VSM definitions changed accordingly. Note that the inclusion of this new definition required an extensive re-write of the VSM concept. Therefore, the new VSM scale will hereafter be annotated as VSM Revision 1 (VSM r1).
		7) Movement of 9902 from Study to Recommended Practice 9902 status, authorizing limited applications of DV format video
		8) Explanatory/editorial changes.
		   a) Added Table of Contents
		   b) Expanded References
		   c) Added Glossary of Acronyms

12 Aug 1999	1.4	GSMC-ISMC Approved
20 October 1999	1.5	20 October meeting of VWG approved and recommended to GSMC-ISMC the movement of Metadata Studies 9712, 9713, 9716, 9717, 9718 to STANDARDS status; new Study 9906 on Segmentation and Re-assembly of KLV Packets; identification of relevant VWG documents for metadata standards; update to VISP version chronology; editorial changes.

Date on Document	Version Number	Notes/Status
24 February 2000	1.5	GSMC-ISMC Approved.
27 July 2000	1.6	Presented at the Motion Imagery Standards Board Meeting. Incorporates the following changes: 1) Editorial changes related to the change from VWG to MISB 2) Adoption of SMPTE Standards and Recommended Practices for Metadata Dictionary and KLV encoding protocol 3) Adoption of MISB Standard 001-720P to update to multiple frame rates including 24, 25 and 50 Hz
02 November 2000	1.6	GSMC-ISMC Approved.
7 February 2001	1.7	Approved by the Motion Imagery Standards Board. Incorporates the following changes: 1) Editorial changes in terminology from video to motion imagery 2) Acceptance of SMPTE 305.2M-2000, Serial Data Transport Interface; Movement of 9803 from Study status. 3) Acceptance of SMPTE 296M-2001, 1280 x 720 Progressive Image Sample Structure; Replaces the identical MISB Standard 0001-720P, which has been rescinded. 4) Acceptance, upon 30-day review, of RP – 0101, MPEG-2 System Streams 5) Acceptance, upon 30-day review, of RP – 0102, Security Metadata Universal Set; 6) Acceptance of four items for Study; 0103 - Timing Reconciliation; 0104 - Predator Engineering Guideline for Closed Captioning; 0105 - Unmanned Vehicle Metadata Sets; 0106 – Advanced File Formats *(direct request to GSMC/ISMC)* 7) Cancelled Study items 9905 and 9906
1 March 2001	1.7	GSMC-ISMC Approved.

Date on Document	Version Number	Notes/Status
24 May 2001	1.8	Submitted to the Motion Imagery Board for approval on 24 May 2001. Substantive changes are: 1. ITU-R BT.1358 replaces SMPTE 293M as the Enhanced Definition Standard 2. Adopts RP 0103 - Timing Reconciliation Universal Metadata Set for Digital Motion Imagery 3. Adopts Engineering Guideline 0104 - Basic Predator KLV Metadata 4. Adopts RP 0106 on Advanced Authoring Format 5. Adopts RP 0107 on Material Exchange Format 6. Updates to SMPTE RP210.3 metadata dictionary from RP210.2

11 October 2001	2.0	Submitted on 11 October 2001 to the Motion Imagery Board for provisional 30-day approval. Substantive changes are: 1. Editorially revised to be NATO friendly 2. ISO/IEC 13818-1, *Information technology - Generic coding of moving pictures and associated audio information*, Part 1: Systems, 2000 (also known as MPEG-2 Systems), includes amendments and replaces 13818-1, 1995 including Amendment 1: Registration Procedure for Copyright Identifier, Amend. 2: Registration of Private Data, and Draft Amendment 3: DSM-CC and Private Data. 3. ISO/IEC 13818-2, Information technology - Generic coding of moving pictures and associated audio information, Part 2: Video, 2000 (also known as MPEG-2 Video), includes amendments and replaces 13818-2, 1995 including Amendment 1: Registration Procedure for Copyright Identifier, Amendment 2: 4:2:2 Profile, Amendment 3: Multi-view Profile, and Draft Amendment 4: ITU-T Extension Code Assignment. 4. Adopt RP on Bit and Byte Order. 5. Adopt MPEG-2 Amendment for Synchronization of Metadata.

63

6. Adopt the Revised Metadata RPs.

7. Adopt Study on Scathe View Metadata.
8.

21 March 2002	2.0a	Editorial Changes 1. Extended definition and Enhanced definition used interchangeably. Use Enhanced throughout the document 2. Change Joint to Coalition 3. Add 25 Hz progressively scanned to frame rate section 4. RP 9720c, d and e – Revise unexplained changes in text from previous version, e.g. 2.1.4.1.1 revised back to T3, ATM 5. Dates updated in References to same as text 6. Added IEEE 1394 to References 7. Added to Acronyms and Abbreviations